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Naval Training for Civilians

A NAVAL training cruise for civilians, authorized by the Navy Department of the United States, will begin on August 15, and last until September 18. The course of training is to be given on board reserve battleships, and citizens of the United States who are between the ages of nineteen and forty-five, and who are physically fit, will be recruited by naval districts and the ships will be allotted according to the number of recruits accepted in different districts. This commendable movement will give an opportunity to those who have had experience in marine engineering to render valuable service to their country. During the final week of the course residents of the district who own yachts or motor boats which would be useful as auxiliaries in time of war, will be given an opportunity to operate in conjunction with the ships. Any of our readers who are interested in this movement can obtain full particulars by writing to the Navy Department, Washington, D. C.

The Shipping Bill

ALTHOUGH the Administration shipping bill has been passed by the House at the time of going to press with this issue, it remains to be seen what disposition of this measure will be made by the Senate. If no other result is accomplished, the proposal to create a United States Shipping Board should become a law. Under existing conditions there is so much vagueness and uncertainty as to what should be done to place the American merchant marine on a sound basis for permanent growth in competition with the world's shipping that means should be provided immediately for making a thorough investigation and study of the actual needs of American shipping and for the examination of the navigation laws of the United States, so that necessary recommendations can be made to Congress for the revision of rules and regulations relating to shipping. With a United States Shipping Board, composed of the best qualified men in the marine field, empowered to work out on common sense lines a systematic and feasible method of fostering shipping, many of the difficulties in the marine field would soon be eliminated. If such a board is provided with an appropriation for the purpoe of building, purchasing, leasing or chartering a limited number of vessels to meet immediate emergency needs and to encourage the development of foreign commerce, it is not to be presumed that such an arrangement would work to the detriment of private ship owners. If such a board is to be the guiding hand in the future development of the American merchant marine, surely it can be entrusted to exercise sound judgment in the initial stages of establishing an efficient steamship service and to look after the best interests of American ship owners in the future. The bill should be passed.

Standardized Ships

NUMEROUS proposals have been made in recent months by shipbuilders in the United States for the systematic building of standard types of merchant cargo vessels. These proposals have been made, of course, with a view to securing the rapid and economical construction of a comparatively large number of vessels to meet the urgent demand for new tonnage, which has been prevalent since the war began. It is believed that by standardizing construction the time and cost of building can be materially reduced. If the proposals had come from the ship owners, they probably would have met with immediate success, but it has always been the case that ship owners have refused to surrender their personal preferences and ideas to standard designs, and no matter how successful a type of vessel may be, it is difficult to convince different owners that their requirements will be amply served by a standard design without modifications, which in many cases are needless, and which eventually increase the cost of construction. The same difficulty prevails, not only in hull work, but especially in machinery installations and fittings and equipment. With so many different types of propelling and auxiliary machinery opening up possibilities of varying degrees of economy in operation, it perhaps is too much to expect that standards of machinery would be advisable. In a great measure, however, standardization of design and construction in hull work, and particularly in fittings and equipment, could be worked out profitably.

Economical River Transportation

EXPERIMENTS to determine the most economical method of transportation of heavy freight by improved types of boats on the Mississippi River have been provided for by an amendment incorporated by the House of Representatives in the Rivers and Harbors bill. Several years ago Congress appropriated half a million dollars to be used by the Engineer Corps of the United States Army for designing and constructing experimental towboats, barges and loading and unloading facilities for towing and delivering freight along the Mississippi River and other Western rivers. Although only a small part of this appropriation was used for this purpose, a voluminous report was returned to Congress by the Commission of Army Engineers appointed for this purpose. This Commission investigated thoroughly the inland navigable waters of Europe and by its investigations both at home and abroad was able to make recommendations as to the most suitable types of boats for economical speed for upstream towing, the most economical types of barges and the class of propelling machinery for river boats. In general, two types of boats were recommended, the stern wheel and the tunnel stern screw propeller boat. The

Army Engineers are now authorized to use a portion of the unexpended balance of the earlier appropriation for making such experiments with these two types of boats, as will fully demonstrate the economy in the transportation of heavy freight on the Mississippi River. These experiments are to be carried out at varying stages of the river and are to be completed within two years.

Valuable as the work of the Army Engineers has been in this direction, it has yet failed to solve the difficulties of western river boatowners in developing river freight traffic. It does not appear just how much gain in economy can be expected by improving old methods of river transportation, or if the reduced cost of operation alone would make such development profitable.

Fire Protection on Steamers

The Board of Supervising Inspectors of the United States Steamboat Inspection Service has adopted a rule approved by the Secretary of Commerce requiring that steamers more than 150 feet in length, carrying passengers, or passengers and freight, contracted for after June 30, 1916, shall have the funnels protected by an iron or steel trunk or casing, extending through all decks above the connection of the funnels with the boilers or breechings. If the engine room compartment extends above the main deck, it is to be protected through all decks by iron or steel bulkheads and by an iron or steel trunk extending through the upper deck. After December 31, 1916, all steamers carrying passengers, which also carry freight upon the main deck, which is accessible to passengers or crew, are to have the main deck freight space protected on the sides and overhead by sheathing of sheet steel or iron, or of a substantial non-combustible material; or, in place of this, the space is to be protected by an efficient overhead water sprinkling system. The crew and passenger accommodations located below the main deck on steamers regularly engaged in the passenger traffic shall be equipped with an efficient overhead water sprinkling system. These requirements can be readily met, and, in fact, many vessels of the class referred to are already provided with efficient protection of this kind. It is a necessary provision and should have been made long ago.

The Future of the Marine Oil Engine

BY JOHN F. WENTWORTH

The oil engine unquestionably has a great future before it, but in order that this future may be realized in the actual commercial development of this type of motive power certain points must be carefully kept in mind.

The first point to consider is that the oil engine differs from the "gas engine" only in its fuel and means of using this fuel. There is no thermodynamic theory underlying this engine, which is different from the gasoline (petrol) engine, other than the points brought up by the use of such a fuel as is practical for use in commercial vessels in competition with coal-burning vessels.

The briefest possible consideration of this problem is by first taking up the matter of economy, then the fuel which will make this economy possible and the fuel valve which will make it possible to use this fuel.

Economy

In considering the matter of economy, the relative merits of the two and four-cycle types of engine are matters of prime importance. It is generally conceded that the two-cycle has about 10 percent lower efficiency than the four-cycle. This means that power for power the two-cycle uses 10 percent more fuel than the four-cycle. This comes about probably from the frictional loss in the scavenging cylinders and from the fact that a part of the expansive energy of the fuel is lost through the open ports at the end of the working stroke. It is not the purpose to take up this controversy at this place. Space forbids. This difference in efficiency exists and it must be offset by some other feature such as compactness, lightness or cheapness of manufacture, if the two-cycle engine is to be adopted.

One point of prime importance in both types of engine is the fact that about 10 percent of the brake horsepower is consumed in the air compressors for high pressure air. This is a loss which can be properly considered here. The prime use of this high pressure air is to feed the fuel into the cylinder. If it be possible to cut down this loss by 50 percent, then a saving of 5 percent of the fuel used in either type of engine can be accomplished., It is certain that a part of this saving at least can be made by using hot injection air for fuel feeding. In the beginning of this work, the fuel valve was water-jacketed very carefully. This results in assuring that the injection air shall be very cool. The question of how far this should be carried is one of the points for manufacturers to consider and for prospective purchasers to investigate, since it has a very direct bearing upon the performance of the engine.

Another point affecting the economy of the engine is the low mechanical efficiency of the oil engine. This is due no doubt to the high pressures used in the present types of engine. If it be possible to reduce these present pressures, then the mechanical efficiency will rise with the result of greater profits to the purchasers of this type of plant. That this is possible has been demonstrated by actual experiments where heavy fuel has been fired in a cylinder where the pressure was not over 150 pounds in place of the 500 pounds at present commonly used in the oil engine.

In this consideration, to call attention to the great gain in cargo carrying capacity caused by the use of the fuel oil engine would be out of place as an old story.

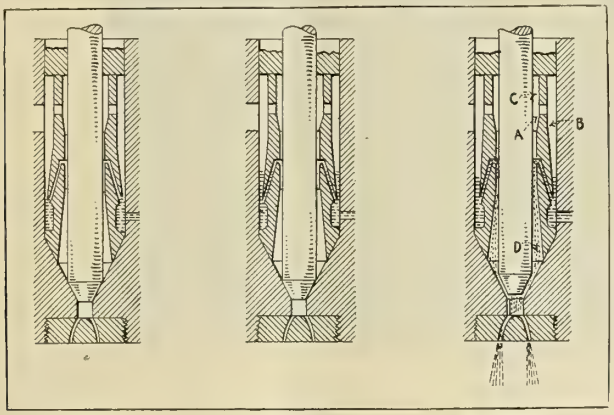
The matter of fuels and fuel valves has been taken last as the part of universal interest to all. The matter of savings in injection air and in reduced pressure are mentioned simply as subjects for individual study and consideration. The matter of fuels can be grasped by all regardless of technical training.

Fuel

Recently the agent of an oil engine advised in the engineering press against the use of the extreme low grades of fuel for the oil engine. My purpose is to try to show the folly of such advice. We see the world today trying to catch up with the demand in the matter of gasoline (petrol). It is my purpose to warn prospective purchasers of oil engines from being caught in the position of the automobile users. The gas oil is a refined product. It is not used in steam plants for fuel. In other words, it is the gasoline (petrol) of the oil engine. When gasoline (petrol) was first used for power purposes it was a by-product from the production of kerosene (paraffine). For years it was reasonable in price till the rapid production of gasoline (petrol) engines has caught up with the production and made the price almost prohibitive. The same will happen with any fuel which is of use only for the oil engine. The oil engine which cannot be caught by the high price of fuel is the engine which uses the same fuel which is used by the steam plant. Users of oil engines, you can only rest assured of the future so long as you are using the same fuel

which is being used by the steam plants. Owing to the fact that the steam plant has an efficiency of around 10 percent the oil engine with its 30 percent efficiency will be safe from a pinch in price of fuel so long as this is the condition.

The only sensible difference between the gas oil and the steaming oils lies in the viscosity. This makes it more difficult to atomize. Would it be worth while for the motor ship to buy steaming oil and refine it or treat it so that a form of gas oil could be made? It certainly would be, provided that the expense of the operation would not be prohibitive. This process simply calls for the fuel to be heated. Oils of an asphaltum base, which is the class to which the steaming oils belong, increase their Baumé one degree for about every 15 degrees rise in temperature. This means that a fuel of 19 Baumé, which would be a very low grade fuel, if heated to about 300 F. will have a Baumé of 33 degrees. This will compare very favorably with gas oil. After this heavy oil



Injection stroke completed. Valve just closed | Fuel pump stroke completed. Valve still closed | Working stroke. Valve open, feeding fuel

Diagrams Showing Operation of Hesselmann Fuel Valve

has been treated in this manner it will in every way be the equal of gas oil so long as this temperature has been maintained.

What is the present advantage in the use of this heavy fuel? The fuels have practically the same calorific value per pound. Fuels are bought by the bulk. Oil of 19 Baumé has a specific gravity of 0.94. Oil of 33 Baumé has a gravity of 0.85. The difference in price between steaming oil of 0.88 gravity and gas oil of 0.85 gravity is about 15 percent in carload lots. The difference in the case of the heavier fuel will be much greater. Besides this difference in price there is the additional advantage due to the fact that a gallon of the heavy fuel will do more work than the same amount of light fuel.

This shows an advantage of over 50 percent at present, besides the assurance against a pinch in price later. Is it worth taking a little trouble for? Can you buy an engine which will use this fuel? It certainly is worth the trouble to use this heavy fuel. You can get the engine if you ask for it. Naturally the builder will advise against this type of engine because its construction is more difficult in all parts pertaining to the fuel handling. No oil engine manufacturer will deny that he can build this type of engine. If he does, go to a builder who can. There are engines in operation to-day which are using this type of fuel. The Palo Alto engine (an engine bought and installed in the municipal plant in Palo Alto, Cal.) has been running on this oil for a year with good results. The fuel used in this engine has been of 15 Baumé.

Motor ship owners, do you want to use this cheap fuel? If you do, demand it in your guarantee and you will be surprised at the number of firms which will be willing to meet this condition.

Fuel Valves

The various types of fuel valves have been described in print so that their elements are familiar to all. It will be more to the point to consider what to look for in a good fuel valve. The fuel valve to handle the oil the owner wants to use must be equipped to handle sluggish flowing oils. This type of oil can be improved by heating, but at the same time our valve should be the best possible. In the original type of fuel valve the oil was delivered into a space broken up by a series of baffles. When the fuel valve was unseated the air rushing through this tortuous passage was able to break the oil up and deliver it in a fine spray. To secure perfect results with a valve of this sort using the heaviest grade of fuel is very difficult, if not impossible.

The fuel valve is the oil engine's carbureter. It must be perfectly reliable. To be able to get this result, it is only needed to study the action of the familiar nasal atomizers. The can draw free flowing oil and deliver it in the form of a suitable spray. If one takes a standard nasal atomizer and fills the glass with gas oil, it will be found that a perfect spray can be obtained. If we substitute in the household article, heavy oil in place of the light oil, it will be found that no spray can be produced. What is the reason? Simply that the siphonic action is not strong enough to lift the heavy oil. This suggests to us that any fuel can be sprayed if we force a stream of fuel into a stream of high pressure air at right angles to this air. In this way the action is absolutely positive.

One fuel valve of this type, the Hesselman fuel valve, is at present on the market. In the figure showing the operation of this valve the different parts of the passages are lettered. As long as the valve is closed the air pressure at *A*, *B* and *D* is equal. As soon as the valve is unseated owing to restricted passage from *A* to *D*, while the pressure in *A* and *B* are equal, the pressure in *D* is reduced. The available pressure forcing the fuel into the stream of air will depend upon the size of the passage into the cylinder, the size (cross sectional areas) of the restricted passage, and whether the fuel passage from *B* into the restricted passage between *A* and *D* is near to *A* or to *D*. The only objection to this valve is that once it is built it is suited to a certain condition by the proportions of valve. The fuel is delivered at right angles to a moving stream of air and it seems reasonable to think that any fuel can be used in a valve of this type. This valve does not act on the siphon idea, but on the principle of a positive pressure behind the oil forcing it into the stream of air. This element of positive pressure behind the fuel seems to be the most desirable element in the fuel valve.

Summary

Finally, in considering different types of engine for installation, do not be misled by the great saving at present in the use of any type of oil engine. Remember that fuels which are cheap now may be dear before your engine is scrapped. Demand an engine which will use the sort of fuel which is used under the steam boilers. If you decide to install a two-cycle engine, remember that at the start you are giving a 10 percent handicap to your competitors who use a four-cycle engine, and make the builder show you very clearly how you are to make up this 10 percent handicap.

When these questions are settled to your satisfaction you can not be far wrong in your selection of the engine for your fleet.

FROZEN BEEF FOR EUROPE

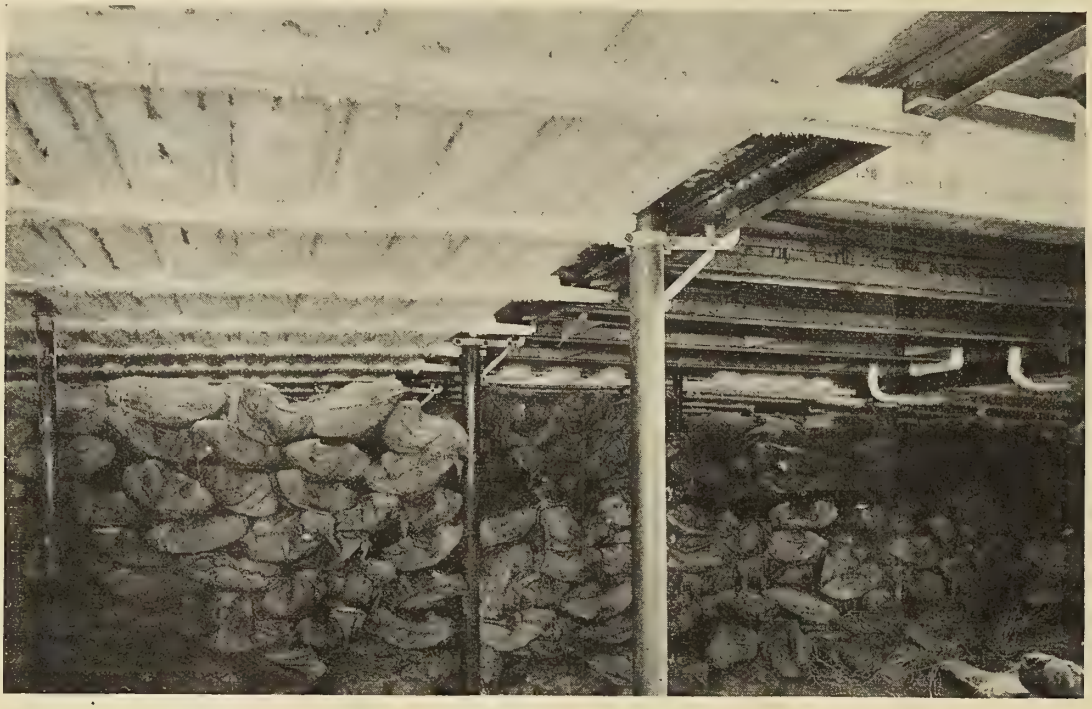


Fig. 1.—Cargo Space for Frozen Meat

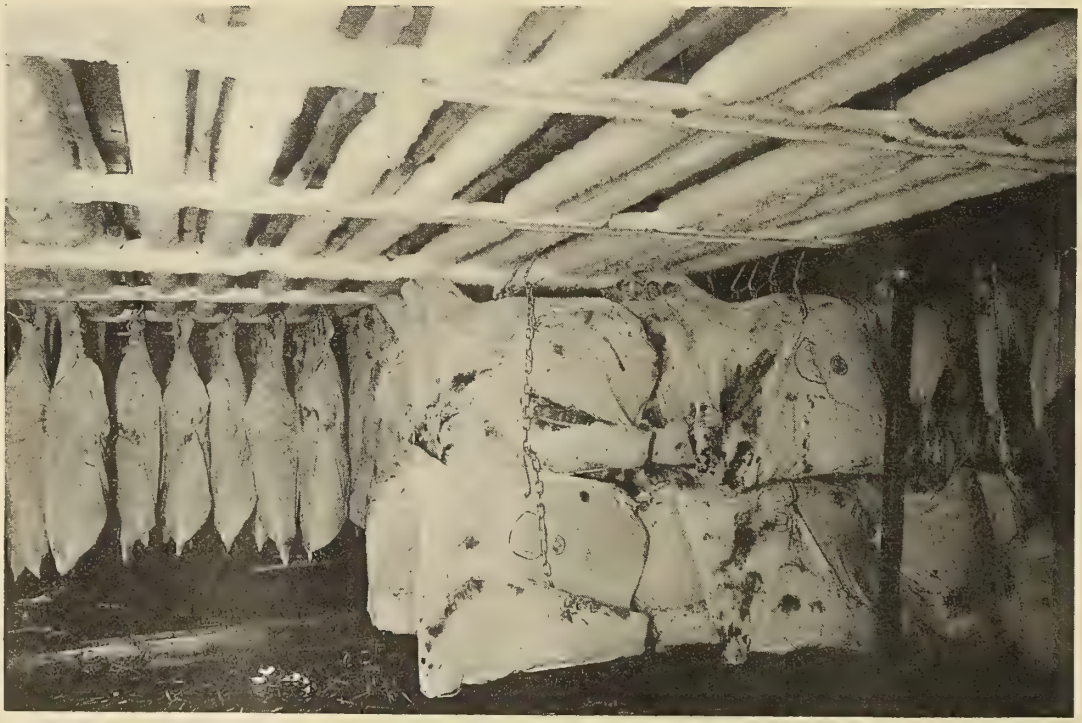


Fig. 2.—Cargo Space for Chilled Meat

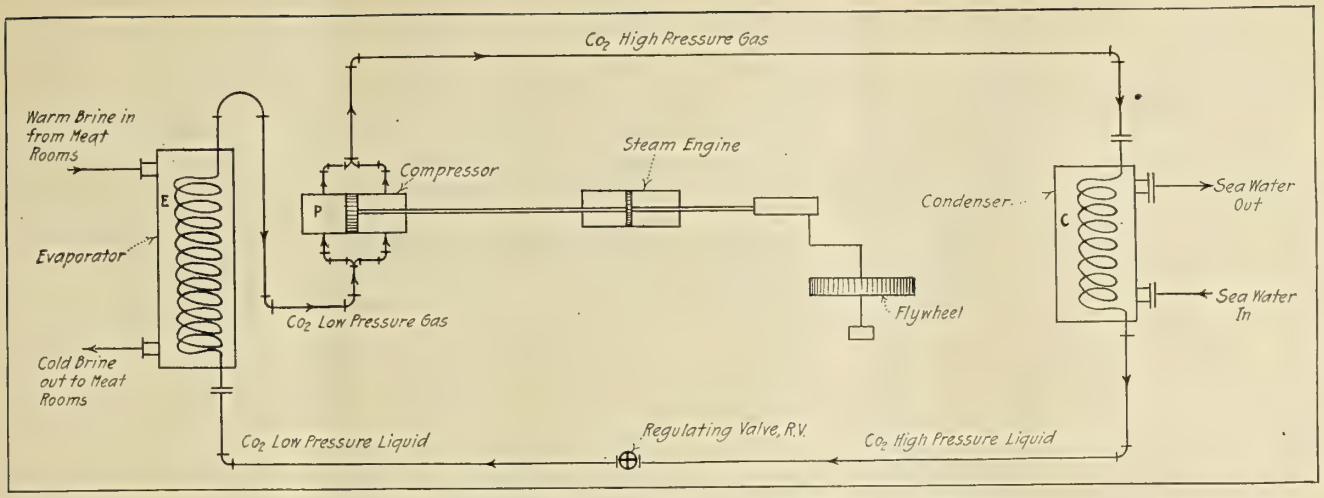


Fig. 3.—Diagrammatic Sketch of Carbonic Acid Refrigerating Plant

Frozen Beef for Europe

S. S. Procida Fitted With Carbonic Acid Refrigerating Plant

AT the end of February, 1916, invitations were received by shipping firms, builders, naval architects and marine engineers to view the completed installation of carbonic acid refrigerating machinery installed by the Shipley Construction & Supply Company, Brooklyn, N. Y., on the steamship *Procida* for the Navagazione Generale Italian of Genoa, Italy, her owners. A large number of persons visited the vessel and viewed this interesting installation and for the benefit of our readers who were unable to visit the ship we are giving the following description:

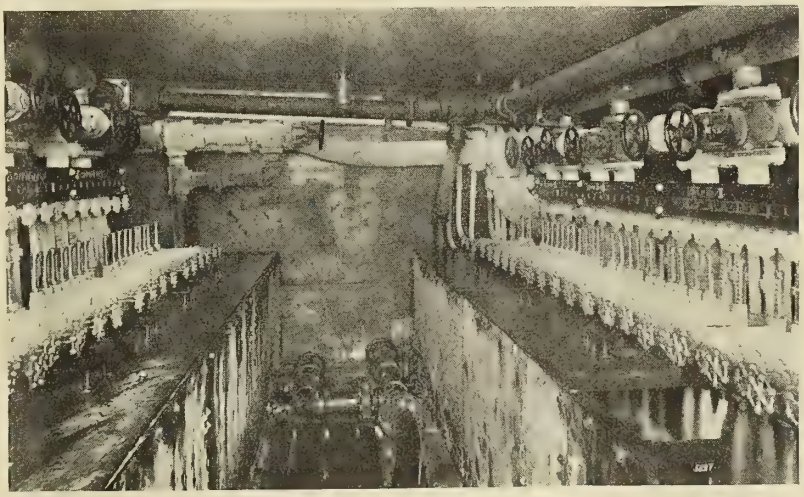


Fig. 4.—Delivery and Return Valves

The equipment of this vessel is a stepping stone in American marine progression, as she has the first large installation of carbonic acid marine refrigeration machinery built and installed in this country for a vessel to carry exclusively refrigerated meat in all her cargo spaces. We trust this will indicate to American and foreign owners and builders that they can now get satisfactory installations of this kind in the United States.

The following is a brief description of the manner in which a carbonic acid plant is used to refrigerate insulated space on board ship for the carriage of frozen meat by the *"brine system."*

The cooling system can be considered as consisting of two complete units.

First—The brine-cooling system, which is used to cool the meat chambers by means of a circulation of cold brine through pipes placed in the chambers. The cold brine is pumped from evaporator tanks by steam-driven pumps and is forced through the pipes in the cold chambers. The brine, in this circulation, is raised in temperature and the meat spaces cooled by an equivalent amount so that the brine returns to the evaporator at a higher temperature than that at which it was drawn from the evaporator by the pump. In order to cool the brine in the evaporator the carbonic acid system, which constitutes the second part of the plant, is used. This is a little more complex in its operation and arrangement, but to make the matter clear, attention is called to the diagrammatic sketch of the system shown in Fig. 3.

Second—The carbonic acid system consists of four principal parts—an evaporator (marked *E*), compressor pump (marked *P*), condenser (marked *C*) and regulating valve (marked *RV*). The carbonic gas, usually indicated by its chemical formula CO_2 and sometimes called carbon dioxide or carbon dehydrate, is contained within the pipes placed in these different parts, and the operation of the cooling cycle is as follows:

Imagine the carbonic acid to be stored as a liquid in the coils in the condenser tank *C*. The regulating valve *RV* is opened slightly to allow a small amount of carbonic acid to flow from the condenser to the coils in the evaporator tank *E*. It is obvious that this liquid would not flow as required unless the pressure in the evaporator

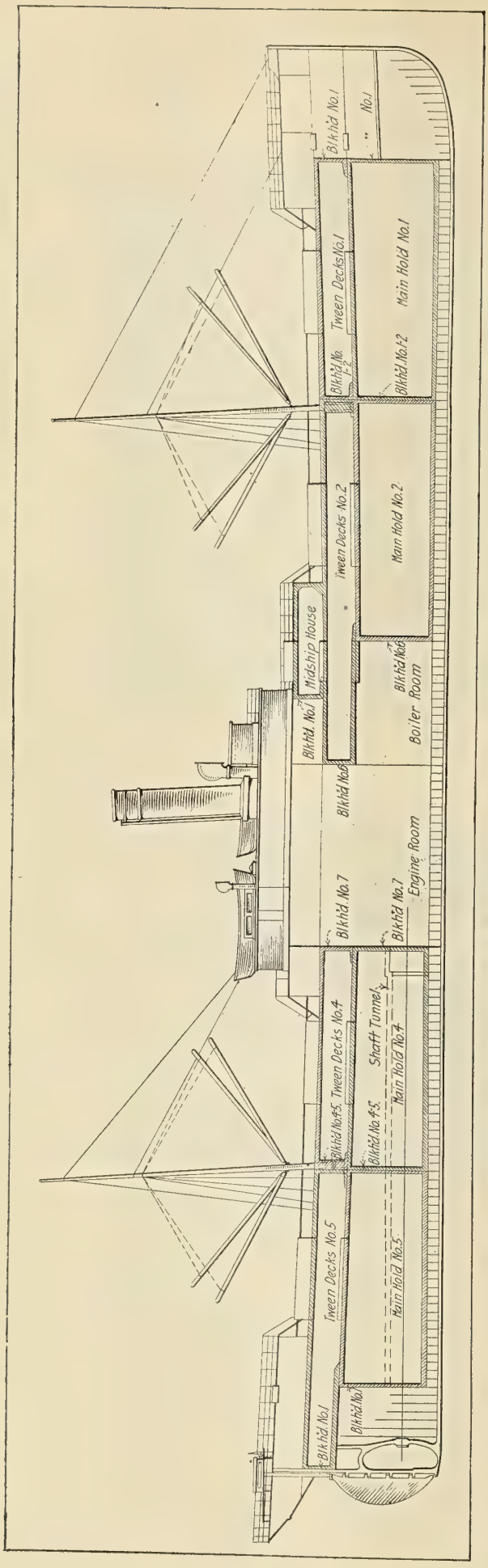


Fig. 5.—Inboard Profile of S. S. *Procida*, Showing Insulated Holds and 'Tween Decks Cargo Spaces

coils were lower than the pressure in the condenser coils; besides, the liquid will require a drop in pressure to cause the flow. The function of the compressor pump *P*, therefore, is to maintain a pressure in the coils *E* lower than in the coils of the condenser *C*. The CO_2 is still in the form of a liquid and it will not assume the form of a vapor unless heat equivalent to its latent heat of evaporation is imparted to it from an outside source. This is exactly the same as converting water into steam in a boiler by means of heat applied externally from a furnace. This source of external heat is the brine in the evaporator tank surrounding the carbonic acid coils contained therein, which, being at a higher temperature than the carbonic acid liquid, by the transfer of its heat converts the CO_2 from a liquid to a gas and the brine is itself reduced in temperature by an equivalent amount.

We now have the carbonic acid in the evaporator in the form of a gas and in order to utilize it again in our cycle of operation it is necessary to convert it back again to a liquid. This is accomplished by means of a condenser *C*, the operation of each being as follows:

The compressor *P* draws the carbonic acid gas from the evaporator coils *E* at a low temperature and pumps or compresses it from the lower pressure in the evaporator to the higher pressure of the condenser and discharges it into the coils in the condenser, still in the form of a gas.

In order to convert it from a gas to a liquid in the condenser it is necessary to abstract from it an amount of heat equivalent to its latent heat of liquefaction. This is exactly analogous to the process in a steam condenser where steam is condensed into water by means of an outside circulation of sea water.

The condenser coils *C* in which the carbonic acid is now located in the form of a gas is surrounded by a circulation of cold sea water, and this cools the gas and converts it into a liquid, the water becoming slightly heated and discharged overboard. The carbonic acid is now in the form of a liquid in the condenser coils *C* and is ready again to be passed through the regulating valve *RV* back to the evaporator coils in continuation of the cycle already described.

From this it will be seen that the carbonic acid is in constant circulation from the condenser through the regulating valve to the evaporator and is forced back by means of a compressor pump into the condenser again. Furthermore, it will be necessary that it does not at any time come in contact with the brine or sea water, there always being the thickness of the pipe intervening between these different substances. Similarly, the brine circulation described as the first part is also a continuation of the cycle of operation, the brine being drawn from the evaporator, discharged through the cooling coils in the meat spaces back to the evaporator again, and so on.

The brine cooling coils in the rooms are shown in Figs. 12 and 13, and the evaporator and condenser tanks and coils (which are exactly similar to each other) are shown in Figs. 9 and 10, respectively. The compressor pump, which is driven by a suitable steam engine, is shown in Fig. 3.

The steamship *Procida* is a spar deck, single screw steel vessel of 3,928 gross tons, built in 1901 in Italy, and is 359 feet 6 inches long, 45 feet 3 inches beam and 18 feet molded depth, provided with triple expansion engines with cylinders 23½ inches, 39½ inches and 64½ inches diameter by 43½-inch stroke of 369 nominal horsepower. There is a large bridge house amidships and four holds and 'tween decks, also a forecastle and poop and five main hatches. All machinery is placed amidships.

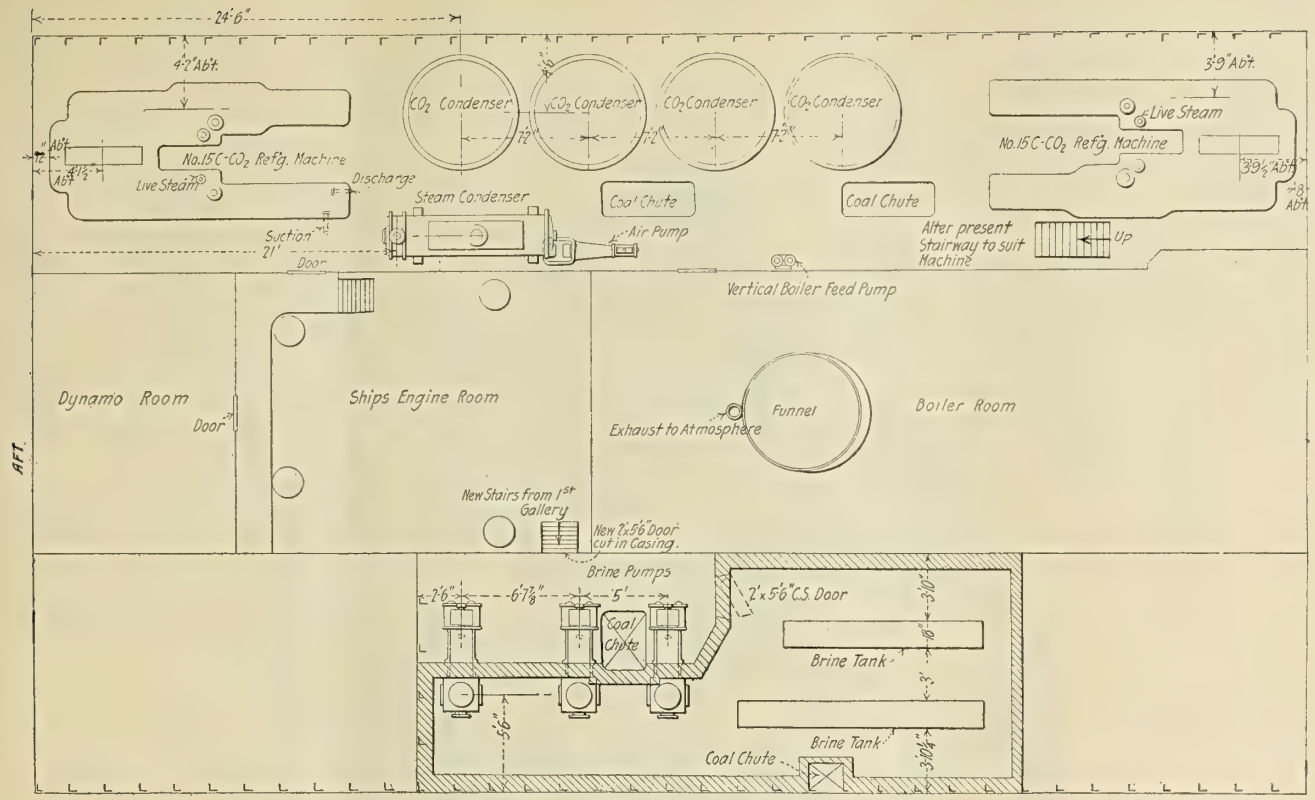


Fig. 6.—General Arrangement of Refrigerating Machinery

As can be seen from the general arrangement plans of the vessel (Fig. 5) each of the nine refrigerated compartments is completely insulated and fitted with insulated hatches. This plan shows that the vessel has the Nos. 1, 2, 3, and 4 lower hold and Nos. 1, 2, 3, and 4 'tween deck spaces and the bridge house space insulated and piped for the carriage of frozen meat cargoes. The insulated capacity of the spaces is 210,000 cubic feet. The *Procida* actually carried 2,100 tons of frozen beef on her first voyage from New York to Italy, where she delivered her cargo in prime condition at a temperature of 10 degrees F. on March 22, 1916.

General Arrangement

The refrigerating machinery is placed in the midship house on each side of the engine room and boiler casings in what was originally bunker space. The machinery is placed on the port side and the brine pumps, the brine return tanks and all their connections on the starboard side. The evaporators are placed on the starboard side at the forward end of the No. 3 'tween decks and below the level of the return tanks and brine pumps.

Fig. 6 shows the arrangement of the refrigerating machinery; with the exception of the evaporators, and Fig. 7 shows a trim plan which will be of particular interest to naval architects, as it shows the pains taken by the contractors to have the machinery so placed as to balance the moments on opposite sides of the vessel. The port weights are 76 tons and the starboard weights 89 tons, but the port moments are 1,156 foot-tons and the starboard moments are 1,157 foot-tons, thus maintaining practically perfect equilibrium.

From Fig. 6 it will be seen that the refrigerating machinery consists of two 50-ton CO_2, double-acting, duplex compound steam-driven machines at the fore and aft ends of the machinery space, respectively, with the four-circular carbonic acid condensers, the independent surface steam condenser and independent air and feed pumps placed between the machines. Through the engine room two coal chutes pass to the wing bunkers below.

The refrigerating engine room has seven side lights and two overhead skylights, with doors for access from the main engine room and bridge deck respectively. This style of machinery construction and arrangement was rendered necessary by the low deck heights and by the necessity of being able to remove the condenser coils through the deck above, their location being such that they clear the overhead waterways and superimposed deck houses.

The three brine pumps have each a capacity of 500 gallons per minute at an easy speed—two working together, circulating 1,000 gallons of brine per minute, perform the duty for the whole vessel. The advantage of a large circulation of brine lies in the fact that it enables an equal circulation to be maintained throughout all the ship's cooling circuits with both the delivery and return valves full open. It has the further advantage of performing the refrigerating duty required with a less difference in temperature between the brine in and out and it results in a more even temperature throughout the cold spaces and a higher initial brine temperature. This last feature enables more work to be performed by the refrigerating plant per unit of driving power and is consequently conducive to direct economy in operation. The exhaust steam lines from the brine, water, air and feed pumps are so arranged that all the pumps are very effectively compounded and produce maximum economy in operation.

It is interesting to note the manner in which the brine pumps have been arranged so that their cold brine ends are inside the insulated room and the steam ends outside, giving easy access to all parts for operation or overhauling without having to disturb any insulation. This feature will be appreciated by those operating engineers who have had to work many hours removing and replacing wet insulation around the cold ends of brine pumps in order to effect some simple repair.

There are two water pumps placed in the lower main engine room, starboard side, one of which is a spare. These pumps, of course, are cross connected and they discharge their water through CO_2 condensers in which its temperature is raised about 3 degrees F.; then through the steam condenser, where it is further raised in temperature about 30 degrees F. This arrangement will appeal to engineers as it enables one pump to perform the work usually requiring two. The rise in temperature of the water in condensing the CO_2 gas is so small that it is immaterial for purposes of steam condensation. At sea the exhaust steam from the refrigerating plant is diverted to the main condenser and the auxiliary air and feed pumps shut down. The circulating water from CO_2 condensers is then by-passed overboard direct by a simple arrangement of valves provided for the purpose. Provision is made for varying the amounts of circulating water passed through the CO_2 condensers and the auxiliary steam condenser respectively.

The auxiliary feed pump for the refrigerating machinery draws the condensed steam from the auxiliary air pump hot well and discharges to the boilers direct through the main and auxiliary ranges or through the feed water heater.

A noticeable point is the careful design embodied in this plant by the contractors to effect maximum economy in operation. The coal required per day to operate the plant averages about three tons for a voyage with a full cargo of frozen meat.

There are two brine return tanks into which the individual returns from the brine circulation systems throughout the vessel are discharged through open connections and each is fitted with a thermometer registering the temperature of the brine coming back from its own particular pipe system.

The delivery and return valves from any one system of piping are placed immediately together, the delivery being above the return; and in addition each one is numbered and named to correspond with the piping plans of the ship, framed copies of which are placed in the engine room to guide the engineers in the operation of the plant. Fig. 4 shows this arrangement with the brine system in operation. Suitable arrangements are provided for heating the brine when desired to thaw out the coils in any meat chamber. This can be done without affecting the other chambers.

Fig. 9 shows the evaporator coils, all of which were tested to 3,000 pounds hydraulic pressure and afterwards to 1,500 pounds air pressure under water. Fig. 10 shows a set of these coils nested together and mounted on the bottom carrying-plate of one of the evaporator tanks, the ends protruding through stuffing boxes. It will be observed that this arrangement allows any coil to be removed without disturbing the remaining coils.

Fig. 11 shows five of the condenser and evaporator tank shells, one of which is on the hydraulic test block. All were tested to twice their working pressure.

Fig. 8 shows one of the cross compound duplex CO_2 50-ton machines, the CO_2 compressors being placed tandem to the steam cylinders. It will be noticed that the machine is so arranged that either side can be operated independently of the other side in case of an accident to one side. In such a case the operating steam side would be single expansion, but in ordinary operation the machine operates cross compound. The high pressure and low pressure steam receiver gages are placed immediately above the steam cylinders and are visible from the operating platform between the two sides of the machine. The machine takes steam from an auxiliary steam line at 150 pounds pressure (saturated) through a reducing valve and exhausts into the auxiliary or main condensers as desired. The machine normally operates at 80 revolutions per minute, but can be driven considerably faster for overload conditions; in fact, these machines were purposely operated at 140 revolutions per minute for 24 hours continuously as an overload trial and ran quite smoothly the whole time.

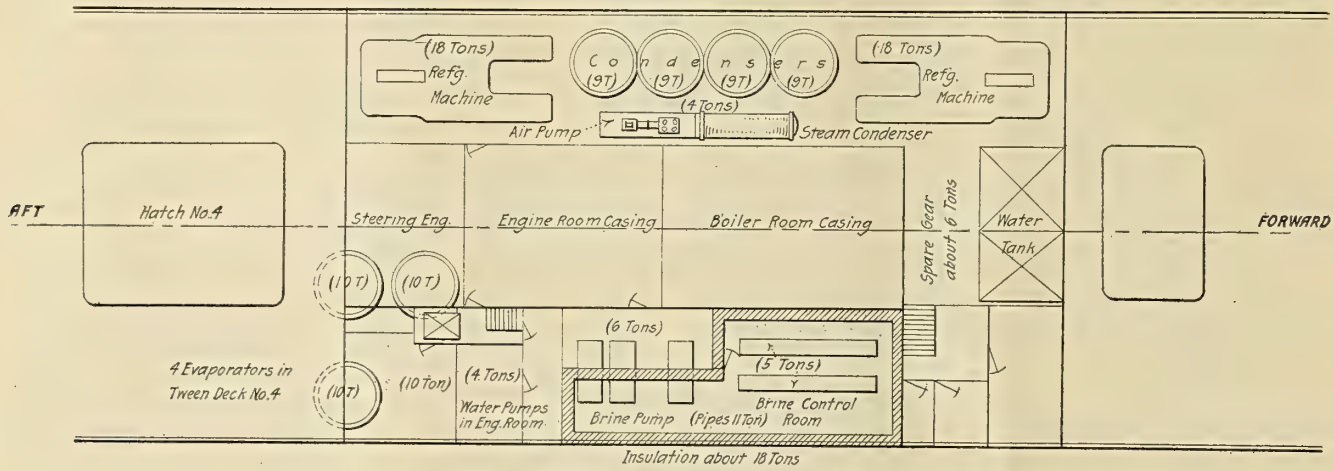


Fig. 7.—Trim Plan of Refrigerating Machinery Space

Co_2 Compressors

The carbonic acid compressors are each machined out of a nickel steel billet, all gas passages, cylinder bore and valve ports being machined to finish dimensions. The bore is ground and polished. The suction shut-off valve is formed integral with the compressor block, and the delivery shut-off valve is a steel block bolted to the side of the compressor (Fig. 8). Each valve has an outside threaded spindle of nickel steel working in a brass-bushed cast steel yoke. Immediately adjoining the delivery gas valve will be noticed the oil accumulator and oil pump reservoir, the former machined out of a nickel steel block and the latter a cast iron oil reservoir containing a hand-operated steel pump for keeping the accumulator fully charged. The oil reservoir and pump are fitted with a suitable brass wire gage strainer of very fine mesh. All the valve nuts and cylinder head nuts are of forged steel, case-hardened after machining. There are two suction and two discharge steel valves for each compressor, all working vertically and in steel cages fitted with separate steel

ONE OF THE CROSS COMPOUND DUPLEX CO_2 FIFTY-TON COMPRESSORS

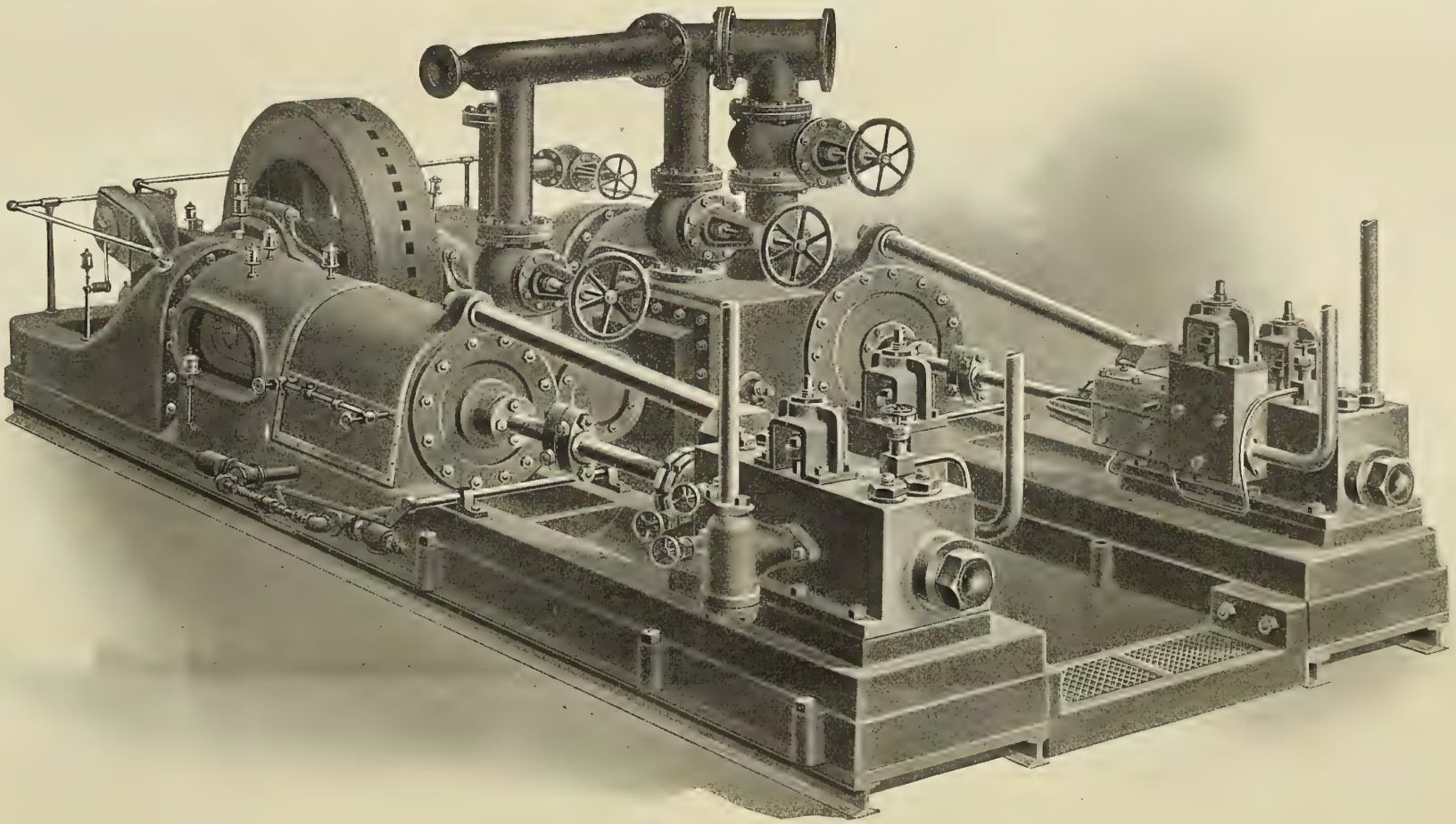


Fig. 8.—CO_2 Compressor

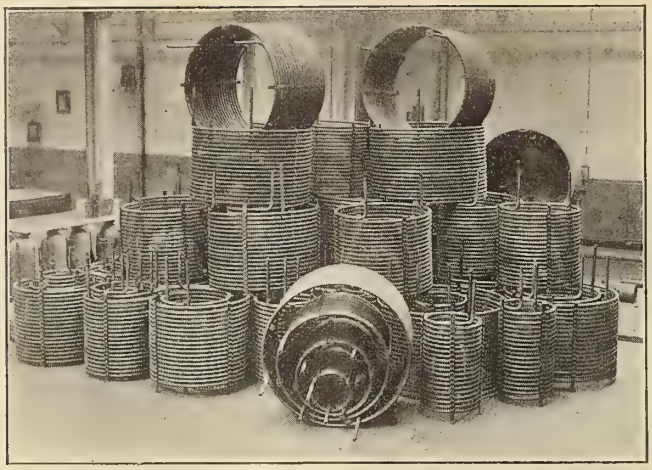


Fig. 9.—Evaporator Coils

Fig. 11.—Condenser and Evaporator Tank Shells

seats. All valves, seats, and springs for both suction and discharge valves are interchangeable, thus reducing the necessary spare gear.

All the CO_2 valves and headers throughout the system are machined from solid steel with malleable iron gland nuts and extra deep packing glands.

The compressor pistons are packed with leathers, the pistons and their rods being machined in one out of nickel steel forgings. The piston rod glands are packed with leathers separated by a bronze lantern gland. The space between the leathers is utilized as an oil reservoir and is maintained automatically at a pressure in excess of the condenser gas pressure by means of the oil accumulator. This system effectively prevents loss of gas from the glands and allows a slight leakage of oil from the glands into the compressor, so as effectively to lubricate the pistons and valves.

Oil passing through the compressor is separated from the gas by suitable steel separators placed between the compressors and condensers. The oil is drained from these separators and after being filtered is again used in the oil accumulator, thus minimizing the amount of oil used. An oil filter is mounted in the engine room for this purpose. The gage board and regulating valves for two CO_2 machines are shown in Fig. 12.

Brine Piping

The brine piping in the cargo spaces (Fig. 13) is arranged on the ceilings, bulkheads and sides and is formed of 1¼-inch wrought iron pipe electrically welded into continuous coils, which are attached to the ceilings by hanger bolts from the ship's beams through the insulation, carrying angle iron supports below the coils. The pipes on the sides and bulkheads are similarly arranged, but are supported by split hardwood grounds securely attached to the insulation grounds by means of lag screws. According to the estimates of the contractors the vessel contains over 22 miles of brine piping, from which an idea may be gained of the magnitude of the work.

To prevent the cargo from coming in contact with the cold pipes, the brine cooling coils on the sides and bulkheads are covered with wooden gratings attached to the pipe supports by lag screws, easily portable and arranged to allow an unrestricted air circulation about the cooling pipes. Figs. 13 and 14 show the arrangements of these cooling pipes and gratings in the No. 2 hold and 'tween deck cargo spaces, respectively, all other cargo spaces being similarly arranged. Fig. 13 also shows the arrangement of the cooling coils in the hatchways, as they appear when viewed from the underside, with the small entrance plug hatch in the way of the ladder removed. It will be noted that the hatch is divided into three sections by thwartship strongbacks carrying the insulated and ordinary cargo hatches, each section having a separate portable cooling coil carried from the hatch framing below the insulated hatch. Each coil has a special hatch by-pass valve attachment so arranged that the brine can be circulated through the remaining coil

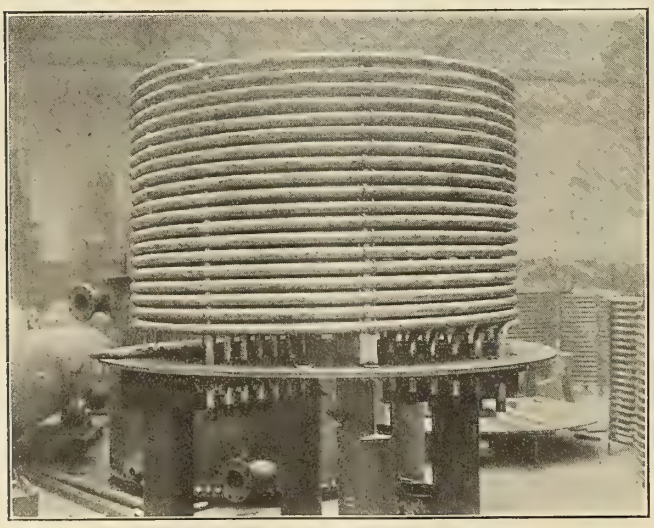


Fig. 10.—Evaporator Coil Assembled

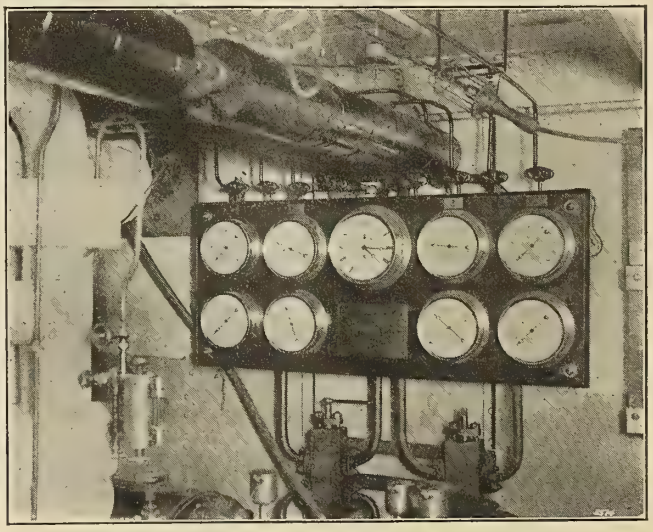


Fig. 12.—Gage Board and Regulating Valves

ARRANGEMENT OF BRINE COILS IN CARGO SPACES

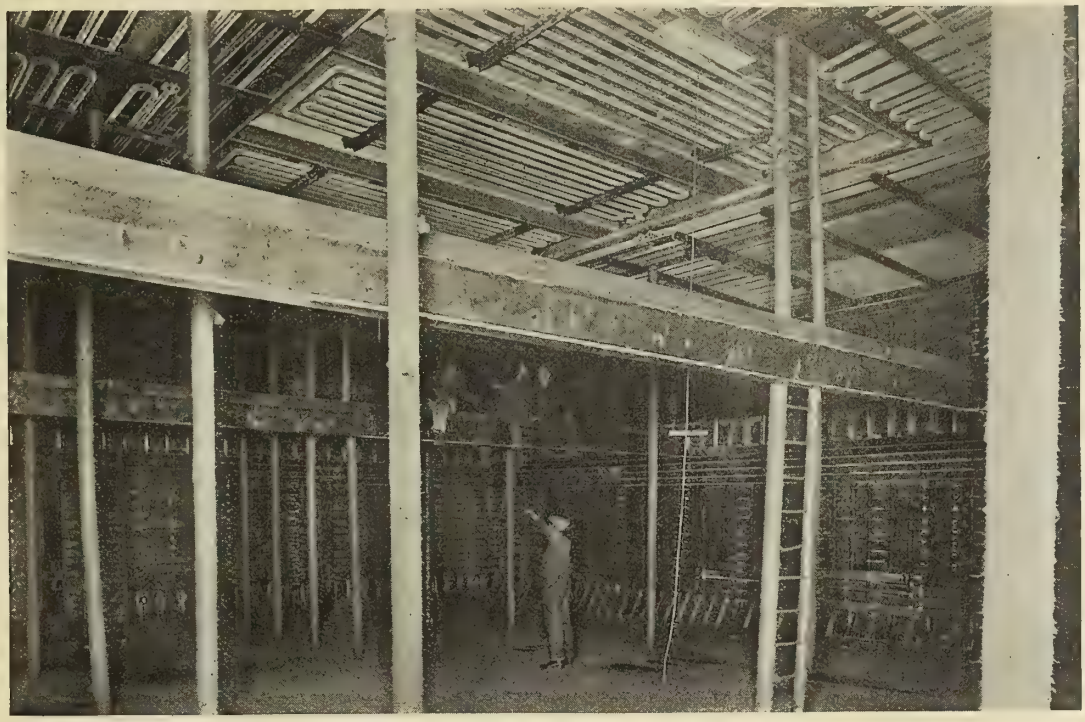


Fig. 13.—Brine Pipes in No. 2 Hold

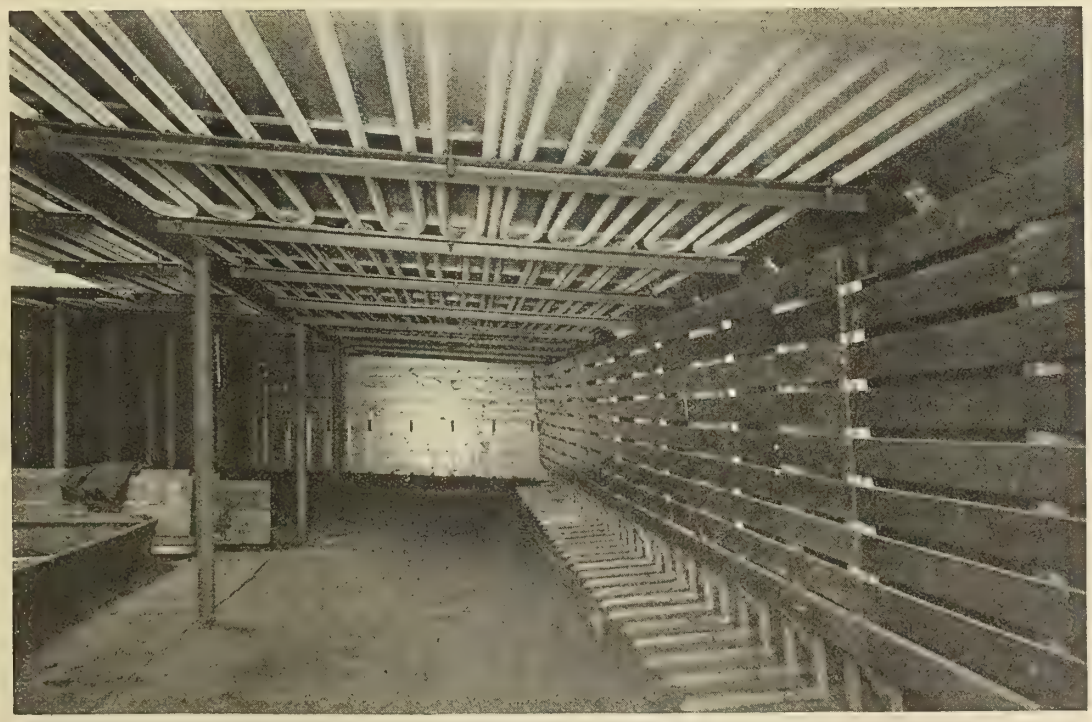


Fig. 14.—Brine Pipes and Gratings in 'Tween Decks Cargo Space

ARRANGEMENT OF BRINE COILS IN HATCHWAYS

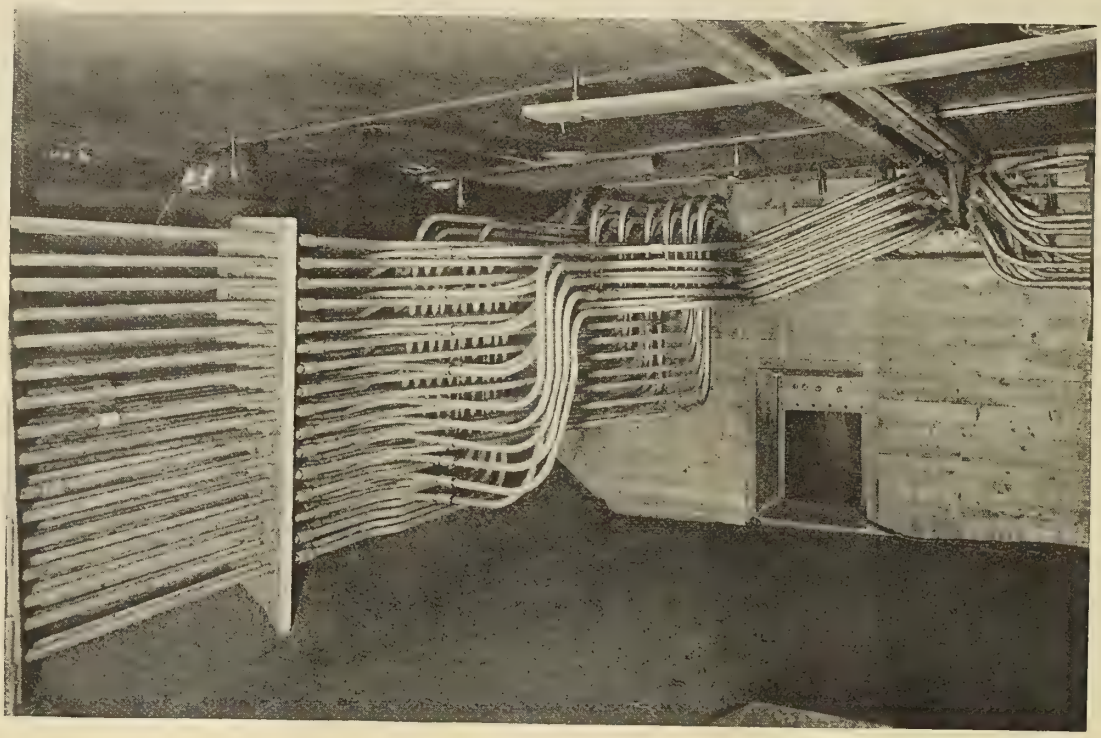


Fig. 15.—Delivery and Return Brine Mains

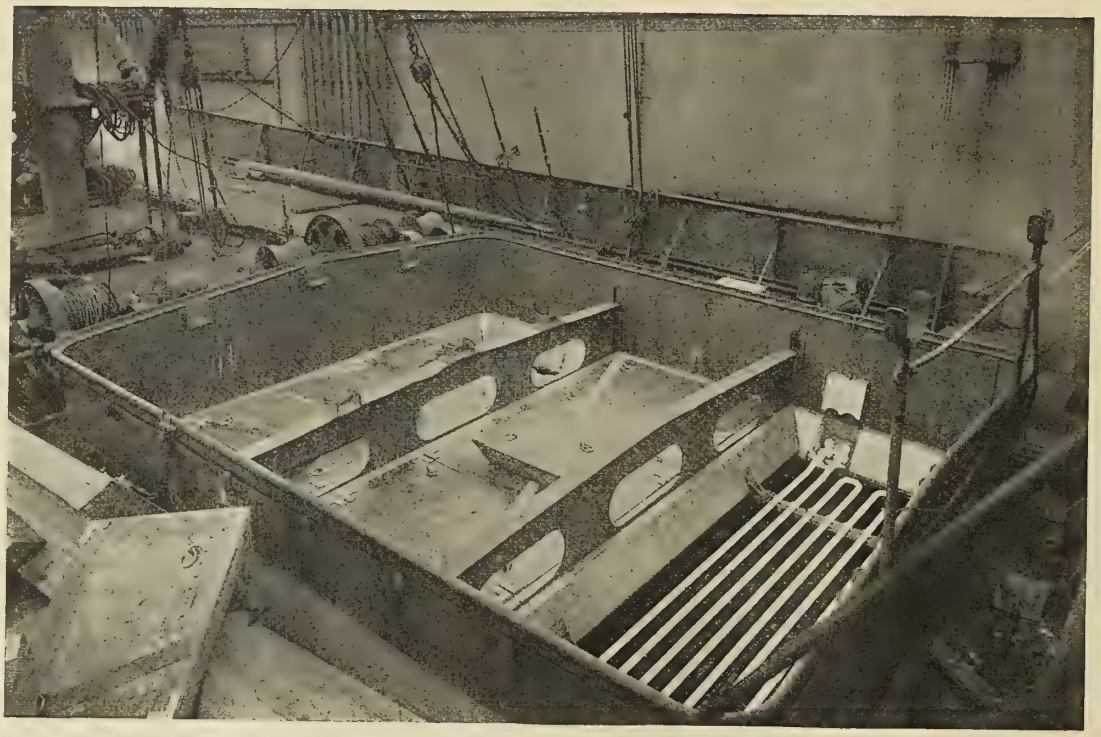


Fig. 16.—Insulated Hatch

MEAT TEMPERATURE LOG

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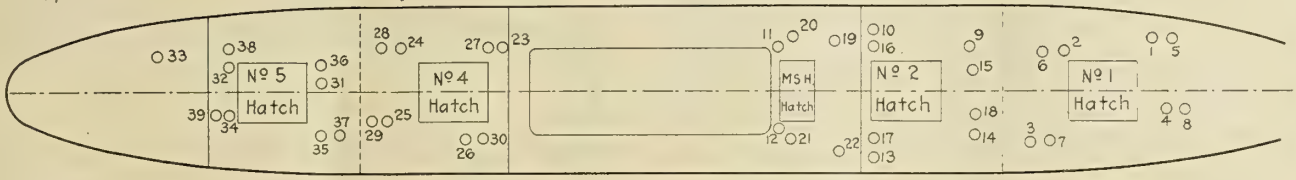


DIAGRAM OF LOCATION OF THERMOMETERS

DATE	TIME	No 1-T.D.				No 1-HOLD				No 2 - T. D.				No 2-HOLD				M.S.H.				No 4. T.D.				No 4-HOLD				No 5-T.D.				No 5-HOLD				REMARKS
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	
May 5 1916	6 A.M.	10	11	9	10	13	14	10	14	12	12	13	11	14	12	12	12	13	15	12	13	13	12	11	12	12	12	12	11	12	10	13	14	12	13	10	14	12	11	13	Left New York March 4th 6.30 P.M.
	6 P.M.	11	11	9	10	13	14	10	14	13	12	14	12	14	12	13	13	14	14	12	13	13	11	12	12	12	12	12	11	10	10	13	14	12	13	11	14	12	11	13	
6	6 A.M.	10	11	10	9	12	14	10	13	12	10	14	12	13	12	14	13	14	13	12	13	12	10	11	13	12	11	11	11	11	10	13	13	12	13	11	14	12	11	13	One Co_2 Machine only in operation
	6 P.M.	12	11	12	11	13	13	10	13	12	11	13	12	13	11	13	13	13	13	13	13	12	11	11	12	13	10	11	11	11	10	13	12	12	13	12	14	12	11	12	
7	6 A.M.	12	12	11	11	13	13	9	12	12	11	13	11	13	11	13	12	13	12	12	12	11	11	10	12	13	10	11	10	10	9	12	11	11	12	11	14	11	10	12	One Brine Pump in operation
	6 P.M.	12	11	11	11	12	12	9	12	12	11	12	11	13	11	12	12	13	12	12	12	11	11	10	13	12	10	11	10	10	9	12	11	11	12	11	13	11	10	12	
8	6 A.M.	12	11	11	12	12	12	9	11	12	11	12	11	12	10	11	12	12	12	11	12	11	11	10	12	12	10	11	10	10	9	12	12	11	12	11	13	11	10	12	
	6 P.M.	11	11	11	11	11	12	9	11	11	11	12	11	12	10	11	11	12	12	11	11	11	12	10	12	12	10	11	9	10	9	12	11	11	11	10	13	11	10	11	
9	6 A.M.	11	11	10	11	11	11	10	10	11	11	11	10	12	10	10	11	12	11	11	11	10	12	10	11	11	10	10	9	10	8	12	11	10	11	10	12	11	10	11	
	6 P.M.	11	11	10	10	10	11	10	10	11	10	11	10	11	10	10	11	11	11	11	11	10	11	10	11	11	10	10	10	10	9	12	10	10	10	10	12	11	10	11	
10	6 A.M.	11	11	10	10	10	11	10	10	11	10	11	10	11	10	10	10	11	11	10	11	10	11	10	11	11	10	10	10	10	9	11	10	10	10	10	11	10	10	11	
	6 P.M.	11	11	10	10	10	11	10	10	11	10	10	10	11	10	10	10	11	10	10	10	10	11	10	11	11	10	10	10	10	10	11	10	10	10	10	11	10	10	10	
11	6 A.M.	11	11	10	10	10	11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	10	10	11	10	10	10	10	10	11	10	10	10	9	11	10	10	10	
	6 P.M.	11	11	10	10	10	11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	10	10	11	10	10	10	10	10	10	9	10	10	10	11	9	10	10	

VOYAGE FROM New York TO Genoa, Italy

SIGNED ---------- CAPTAIN
---------- CHIEF OFFICER
---------- ENGINEER

Fig. 17.—Meat Temperature Log, Showing Week's Record of Operation of the Plant

ENGINEER'S LOG

DATE	TIME	FORWARD MACHINE								AFT MACHINE								VACUUM	WATER TEMP.			BRINE			REMARKS.
		STEAM		R.P.M.	CO_2 TEMP. CENT.					STEAM		R.P.M.	CO_2 TEMP. CENT.						SEA	CO_2 DISCH.	STEAM DISCH.	PRESS.	TEMP.		PUMP STROKE	
		H.P.	L.P.		H.P. $_1$	L.P. $_1$	H.P. $_2$	L.P. $_2$		H.P	L.P.		H.P. $_3$	L.P. $_3$	H.P. $_4$	L.P. $_4$							DEL.	RET.		
May 5 1916	12 P.M.	60	15	90	12	-24	12	-24											50	54		26	6	8	38	Plant exhausting to Main Condenser
	6 A.M.	60	15	90	12	-24	12	-24											50	54		26	6	8	38	Brine Pumps & water Pumps operating Compounded.
	12 M.	60	15	90	12	-24	12	-24											50	54		26	6	8	38	
	6 P.M.	60	15	90	12	-24	12	-24											50	54		26	6	8	38	
6	12 P.M.	60	15	90	12	-24	12	-24											50	54		30	6	8	39	1 Brine Pump working
	6 A.M.	60	15	90	12	-24	12	-24											50	54		30	6	8	39	1 Water Pump working
	12 M.	60	15	90	12	-24	12	-24											52	55		30	6	8	39	
	6 P.M.	60	15	90	13	-24	13	-24											52	55		30	6	8	39	aux. & Steam condenser, air Pump &
7	12 P.M.	60	15	90	13	-22	13	-22											52	55		30	7	8	40	feed pump shut down
	6 A.M.	60	15	90	13	-22	13	-22											52	55		28	7	8	37	
	12 M.	60	15	90	13	-22	13	-22											52	55		28	8	9	37	
	6 P.M.	60	15	90	13	-22	13	-22											52	55		28	8	9	38	
8	12 P.M.	60	15	90	13	-22	13	-22											52	55		28	8	9	38	
	6 A.M.	60	15	90	13	-22	13	-22											52	55		28	8	9	38	
	12 M.	60	15	90	14	-23	14	-23											52	55	By-pass over board open	30	7	9	39	
	6 P.M.	60	15	90	18	-23	18	-23											56	60		28	7	9	38	
9	12 P.M.	60	15	90	18	-24	18	-24											58	62		28	6	8	38	
	6 A.M.	60	15	90	18	-24	18	-24											61	65		28	5	7	38	
	12 M.	60	15	90	18	-26	18	-26											61	65		28	5	7	38	
	6 P.M.	60	15	90	18	-26	18	-26											61	65		28	4	6	38	
10	12 P.M.	60	15	90	18	-26	18	-26											61	65		28	3	5	38	Added 100 lbs. Co_2 to increase charge
	6 A.M.	60	15	90	18	-26	18	-26											61	65		28	2	4	38	in System.
	12 M.	60	15	90	18	-26	18	-26											61	65		28	2	4	38	
	6 P.M.	60	15	90	18	-26	18	-26											61	65		28	2	4	38	
11	12 P.M.	60	15	90	18	-26	18	-26											61	65		28	2	4	38	
	6 A.M.	60	15	90	18	-26	18	-26											61	65		28	2	4	38	
	12 M.	60	15	90	18	-26	18	-26											61	65		28	2	4	38	
	6 P.M.	60	15	90	18	-26	18	-26											61	65		28	2	4	38	

VOYAGE FROM New York TO Genoa - Italy SIGNED ---------- ENGINEER

Fig. 18.—Week's Record of One of the Carbonic Acid Machines

sections when one or more sections are removed for working cargo.

Fig. 15 shows the delivery and return brine mains.

Fig. 16 shows a top view of No. 3 hatch further indicating this arrangement. It also shows the method used in constructing these hatchways with their protecting iron work. The insulated hatches of the forward section have been removed and the hatch coil is ready to be shut off and disconnected for removal without loss of brine or interruption of the brine circulation system.

Meat Stowage

Fig. 1 is interesting in illustrating how frozen beef cargoes are loaded into the refrigerated compartments. The meat, it will be noted, is in quarters and is protected by cloth coverings sewn around them. The meat in this condition is carried at a temperature of about 15 degrees F.

Fig. 2 shows the method adopted in carrying chilled meat and illustrates very clearly, by comparison, the different styles of construction required to meet these conditions. The chilled meat is suspended from overhead meat rails arranged between the brine pipes and is covered with cloth similar to the frozen meat. This method of carrying chilled beef is due to the necessity for an unrestricted air circulation about the meat. The temperatures are maintained at about 28 degrees F.

Insulation

The insulating material on this vessel consists of regranulated cork, sheet cork and mineral wool, each being used as circumstances and position seemed most suitable. The ship's side, under deck, tank top, margin plates and stringer insulation are shown on the midship section (Fig. 19). The ship's side insulation consists of 3-inch by 3-inch grounds bolted to the face of the frames and covered by ⅞-inch tongued and grooved boards. The 9-inch space between the boards and the shell plating is tightly packed with regranulated cork. Over the ⅞-inch boarding is placed 1½-inch sheet cork with nailing strips, and the whole is covered by waterproof paper and a layer of 1⅛-inch tongued and grooved boards. This makes an overall insulation thickness of approximately 12⅜ inches.

The insulation on the underside of the decks consists of 6-inch by 2-inch grounds bolted to alternate frames by ⅞-inch bolts and covered by ⅞-inch tongue and grooved boards. The space between the deck plating and ⅞-inch boarding is packed with regranulated cork. Below the ⅞-inch boarding is packed a layer of 1½-inch cork with nailing strips, and the whole is covered with waterproof paper and ⅞-inch tongued and grooved boarding.

The margin plates of decks and bulkheads are insulated by a heavy hard wood ribbon, fitted and bolted watertight to the top side of the margin plate at four feet from the shell, carrying 2-inch tongued and grooved boarding fastened to the ship's side insulation. The space between the 2-inch boarding and the deck is packed with sheet cork and grouted in with a plastic mixture of granulated cork and pitch.

The insulation in way of beam knees is left portable for easy renewal of insulation filling in case of settlement.

The bulkheads are insulated, as shown on the drawings. Those bordering on the bunkers and engine spaces are packed with mineral wool to minimize the danger of fire.

The insulated limber hatches extend the whole length of the bilges and are shown on the midship section. They have frames and combings worked from solid timbers. Each hatch section is about six feet long and is fitted with two lifting ring bolts. All steel work is galvanized.

Fig. 17 shows a week's record as a typical example of the operation of the plant and records the readings of the several thermometers placed in the meat chambers.

Fig. 18 shows the operation of one of the carbonic acid machines over the same period. The forward machine only was in operation at the time and, in fact, one machine only was used throughout the whole voyage, sometimes the forward machine and sometimes the aft one.

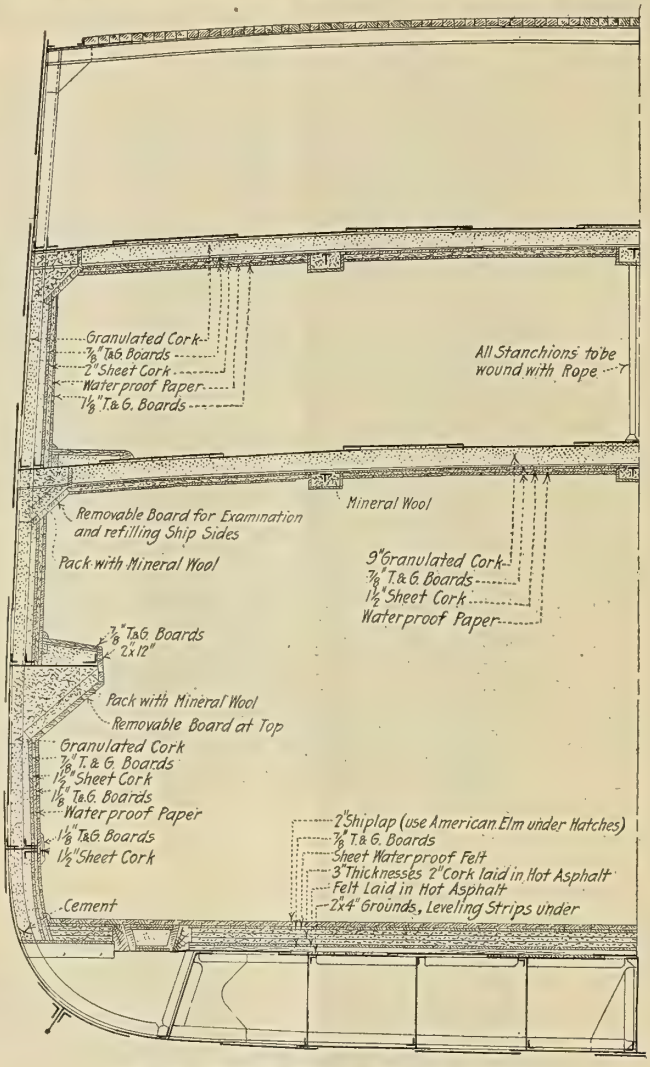


Fig. 19.—Midship Section, Showing Insulation

Fusible Plugs for Marine Boilers.—Amendments adopted by the Board of the United States Steamboat Inspectors on March 31, to its rules relating to fusible plugs, were as follows: Fusible plugs shall be "filled from end to end with tin not less than 99.5 per cent pure," in lieu of 99.7. Fusible plugs shall be renewed at each annual inspection, but in cases where the plugs were installed or renewed not more than six months prior to the annual inspection they may be allowed until the next following annual inspection or for a period not to exceed eighteen months. In such cases, however, the inspector shall satisfy himself at the annual inspection that the plugs are in such condition as to warrant their continued use until the next annual inspection, after which the plugs shall be renewed at each and every annual inspection. Manufacturers of fusible plugs shall furnish the Supervising Inspector-General a sample plug from each heat for examination and test, but where more than 250 plugs are poured from the same heat a sample plug shall be furnished for each 250 plugs, or fraction thereof. The samples furnished shall bear the same number from any one heat.

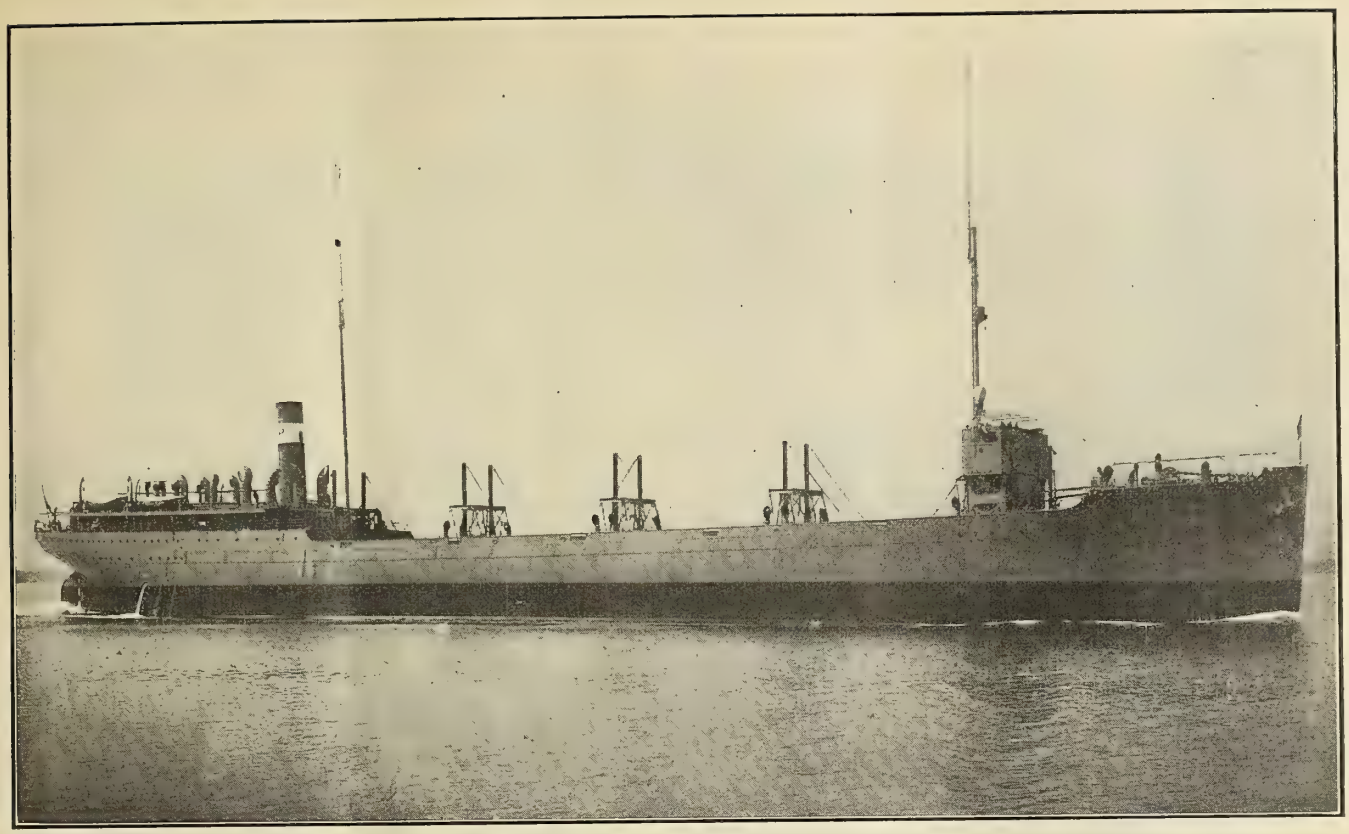


Fig. 1.—Panama Collier *Achilles*, Built by the Maryland Steel Company, Sparrows Point, Md.

The Panama Colliers Ulysses and Achilles

Twin Screw Vessels of 13,563 Tons Deadweight Capacity and 14 Knots Speed Built by the Maryland Steel Company

The Panama colliers *Ulysses* and *Achilles*, built last year by the Maryland Steel Company, Sparrow's Point, Md., differ from the colliers *Orion* and *Jason*, built by the same company for the United States Navy, in that they have no coal-handling appliances. They have, however, two masts for carrying radio gear and signals, and ten king posts for handling the hatch covers, which are of steel made in halves to hinge up.

In the *Ulysses* and *Achilles* there are four cargo holds separated by watertight bulkheads, and two oil holds forward, divided by a centerline bulkhead into four compartments.

Propulsion of the vessel is by twin screws driven by reciprocating engines of 7,200 combined indicated horsepower designed to give the ships a speed of 14 knots at a displacement of about 19,585 tons. The principal dimensions of the vessels are as follows:

Length overall	536 feet
Length between perpendiculars	514 feet
Beam, molded	65 feet
Depth, molded	39 feet 6 inches
Draft, loaded	28 feet 1 inch
Deadweight capacity on above draft	13,563 tons
Displacement	19,585 tons
Coefficient of fineness, block	0.724
Coefficient of fineness, midship section	0.984
Coefficient of fineness, load waterline	0.8
Designed indicated horsepower	7,200
Designed speed	14 knots

Accommodations are provided for 32 officers and a crew of 146 men. An American Engineering Company's steam anchor windlass is located on the forecastle, with a vertical, two-cylinder, 12-inch by 14-inch engine below on the main deck. The steering engine, also of the American Engineering Company's horizontal type, with two steam cylinders, 12 inches diameter by 12 inches stroke, is located on the main deck aft. Aft of the deck house on the poop deck is an American Engineering Company's capstan, operated by a horizontal steam engine with two cylinders 8 inches diameter by 8 inches stroke. There are eight deck winches of the horizontal, double-cylinder type, 8 inches by 8 inches, on the weather portion on the main deck for handling hatch covers, etc.

The propelling machinery is located in the stern and consists of two triple-expansion, vertical, inverted, reciprocating engines supplied with steam by three Scotch double-end boilers, 16 feet diameter by 22 feet 1 inch long, operating under Howden's system of forced draft at a working pressure of 200 pounds per square inch.

The main-engine cylinders are 27½ inches, 46 inches and 76 inches diameter by 48 inches stroke, and are especially designed for high economy. Piston valves are fitted to all cylinders, and all ports are straight, which keeps the clearance volume down to a minimum. The connecting rods are 9 feet 3 inches between centers and are fitted with cast steel boxes, top and bottom. The crosshead slippers are also of cast steel and work on hollow "bar" type guides fitted with water service.

The main bearings consist of bottom semi-circular boxes, fitted into square-bottomed saddle pieces. The caps are of cast steel. This arrangement permits the semi-

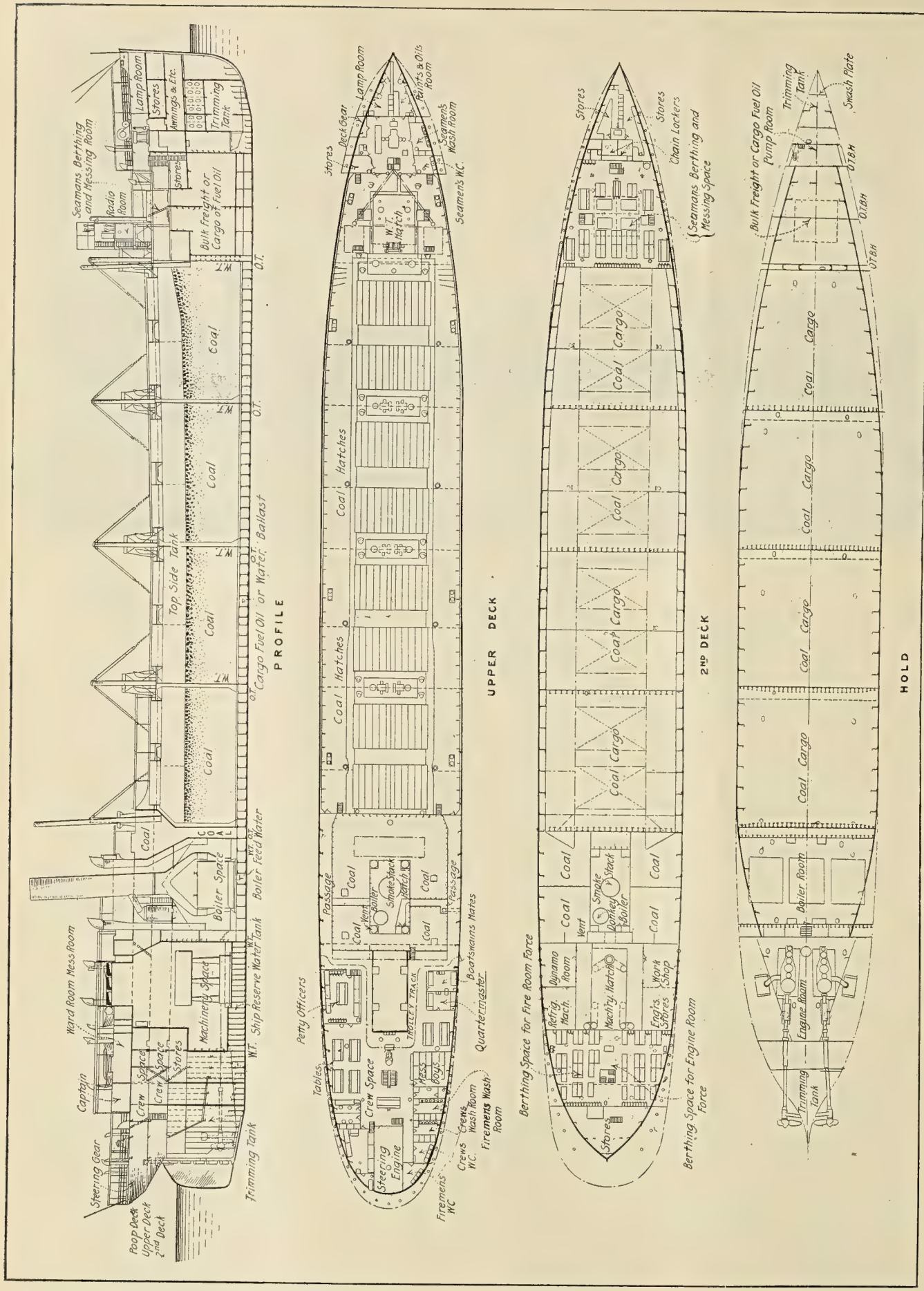


Fig. 2.—Profile and Deck Plans of Panama Colliers *Ulysses* and *Achilles*

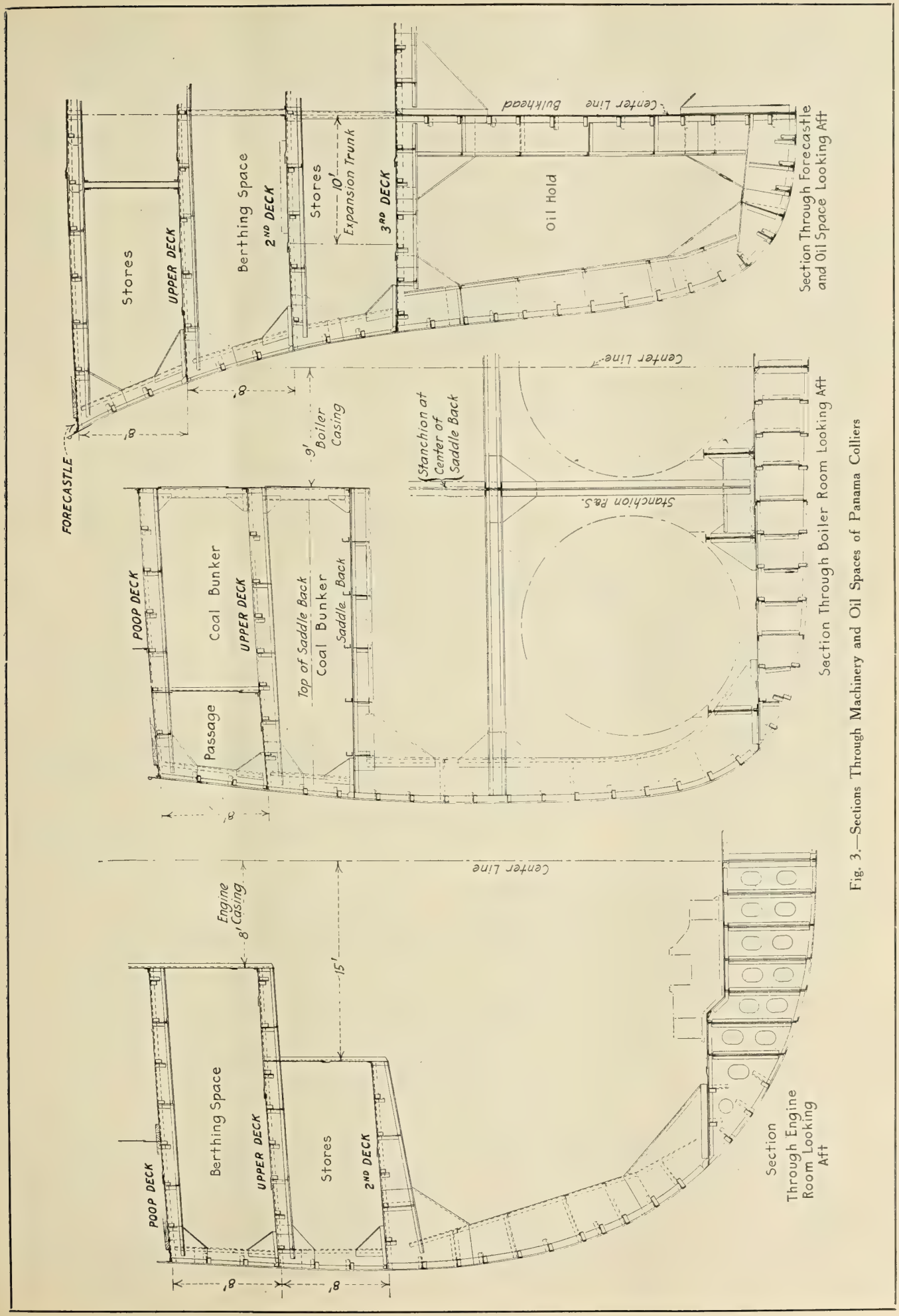


Fig. 3.—Sections Through Machinery and Oil Spaces of Panama Colliers

circular boxes being removed without lifting the crankshaft. The reversing gear is at the back of the engine, and consists of the usual type of steam ram, actuating a steel shaft, which is fitted with cast steel adjustable reverse arms.

The main air pumps are operated by levers from the intermediate pressure cylinder crossheads, and are of the Edwards type, 22 inches diameter by 18 inches stroke.

Steam is supplied, as previously mentioned, by three double-end Scotch boilers, each 16 feet diameter by 22 feet 1 inch long, built for 200 pounds per square inch working pressure to Lloyd's and the United States Steamboat Inspection rules. The total heating surface is 19,635 square feet, and the total grate surface 451 square feet. The boilers operate under the Howden system of hot forced draft, with coal fuel. Each boiler contains eight

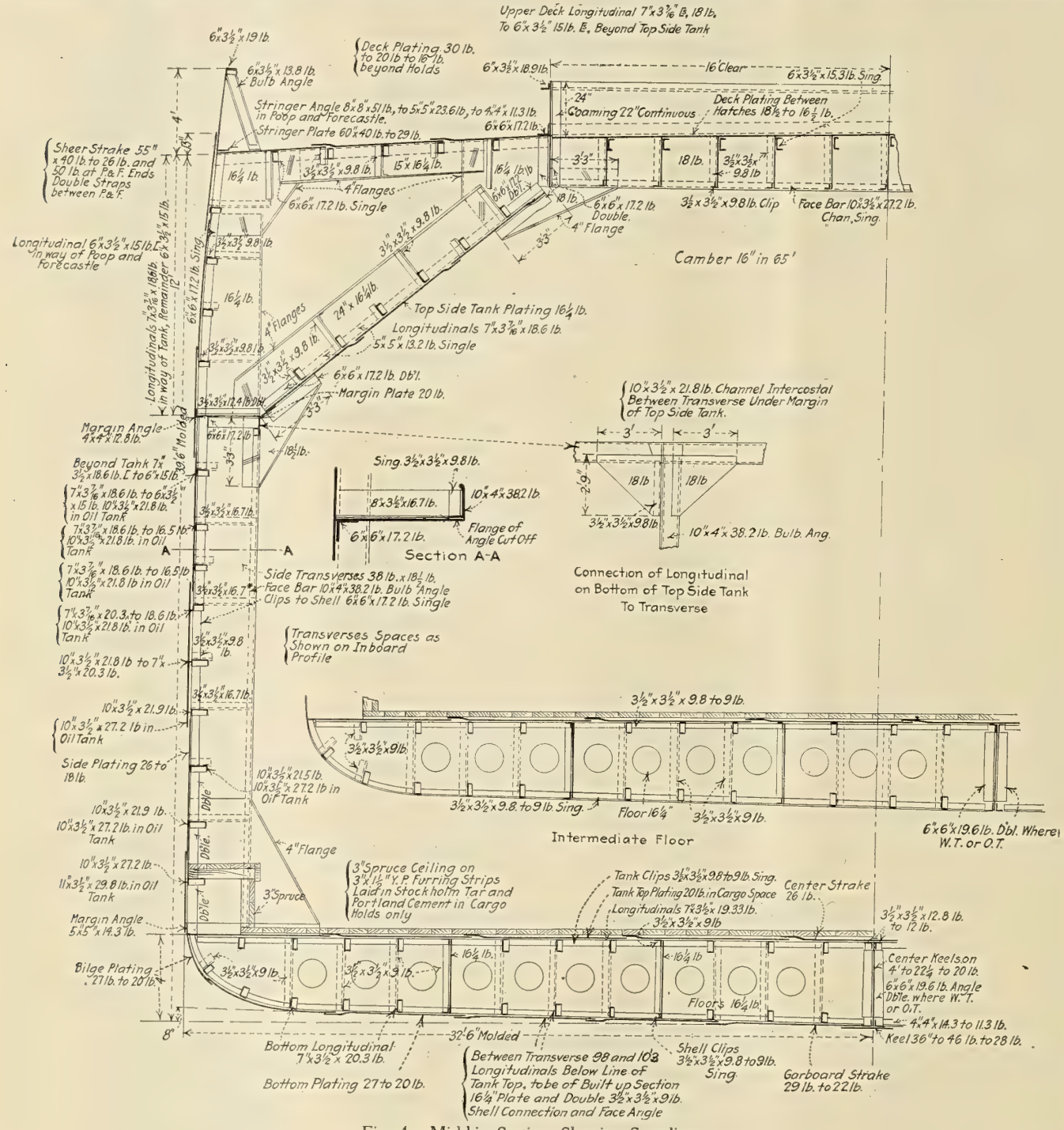

Upper Deck Longitudinal 7"x3 7/16" B, 18 lb, To 6"x3½" 15 lb. E, Beyond Top Side Tank
Deck Plating 30 lb. to 20 lb. to 16 lb. beyond Holds
16' Clear
Deck Plating Between Hatches 18½ to 16½ lb.
24" Coaming 22" Continuous
Stringer Angle 8"x8"x51 lb, to 5"x5"x23.6 lb, to 4"x4"x11.3 lb.
Stringer Plate 60"x40 lb. to 29 lb.
Sheer Strake 55" x 30 lb. to 26 lb. and 50 lb. at P.& F. Ends Double Straps between P.& F.
Face Bar 10"x3½"x27.2 lb. Chan. Sing.
Camber 16" in 65'
Top Side Tank Plating 16¼ lb.
Longitudinals 7"x3 7/16"x18.6 lb.
Margin Plate 20 lb.
Margin Angle 4"x4"x12.8 lb.
Beyond Tank 7" 39.6 lb. Molded
10"x3½"x21.8 lb. Channel Intercostal Between Transverse Under Margin of Top Side Tank.
Connection of Longitudinal on Bottom of Top Side Tank To Transverse
Section A-A
Side Transverses 38 lb. x 18½ lb.
Face Bar 10"x4"x38.2 lb. Bulb Angle
Clips to Shell 6"x6"x17.2 lb. Single
Transverses Spaces as Shown on Inboard Profile
Intermediate Floor
3"Spruce Ceiling on 3"x1½" Y.P Furring Strips Laid in Stockholm Tar and Portland Cement in Cargo Holds only
3"Spruce
Tank Clips 3½"x3½"x9.8 to 9 lb. Sing.
Tank Top Plating 20 lb. in Cargo Space
Longitudinals 7"x3½"x19.33 lb.
Center Strake 26 lb.
Center Keelson 4' to 22¼ to 20 lb.
Floors 16¼ lb.
Bilge Plating 27 lb. to 20 lb.
Margin Angle 5"x5"x14.3 lb.
Bottom Longitudinal 7"x3½"x20.3 lb.
Bottom Plating 27 to 20 lb.
Between Transverse 98 and 103 Longitudinals Below Line of Tank Top, to be of Built up Section 16¼" Plate and Double 3½"x3½"x9 lb. Shell Connection and Face Angle
Shell Clips 3½"x3½"x9.8 to 9 lb. Sing.
Garboard Strake 29 lb. to 22 lb.
32'6" Molded
Keel 36" to 46 lb. to 28 lb.

Fig. 4.—Midship Section, Showing Scantlings

There are two bilge pumps attached to the air-pump crosshead, each 5 inches diameter by 18 inches stroke.

The thrust blocks are of the horseshoe type, the collars running in a water-cooled oil bath.

The propellers are of the built-up type, each having three manganese bronze blades, mounted on a cast steel hub. The wheels are 17 feet diameter, with an adjustable pitch of from 16 feet to 18 feet, and have a developed area of 94.3 square feet.

41-inch inside diameter corrugated furnaces, each having its own combustion chamber. The tubes are 2½ inches diameter and fitted with spiral retarders. There are two multi-vane forced draft blowers, located over the wing boilers in the fireroom.

The following auxiliaries are installed and fitted up in keeping with the highest class of merchant practice:

Two main condensers, each having 5,300 square feet of cooling surface.

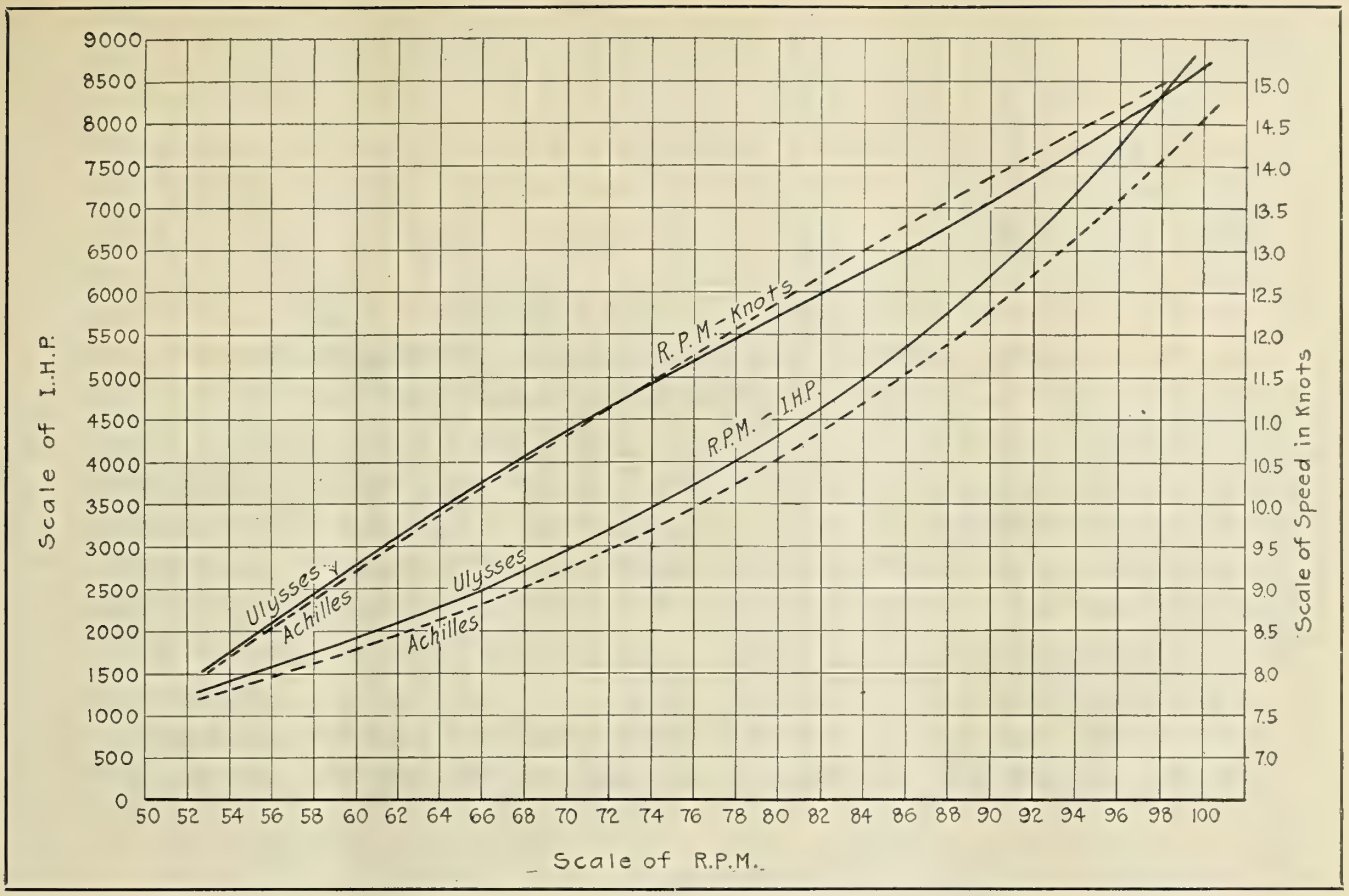


Fig. 5.—Speed-Power Curves from Official Trials of Panama Colliers

Two main centrifugal circulating pumps having 14-inch diameter nozzles and driven by vertical single-cylinder, 10-inch by 9-inch steam engines.

Two main and one auxiliary feed pumps of the vertical simplex type, having cylinders 14 inches and 9 inches diameter by 24 inches stroke.

One fire and bilge pump of the vertical, simplex type, having cylinders 12 inches and 14 inches diameter by 12 inches stroke.

One ballast pump of the vertical duplex type, having cylinders 12 inches and 14 inches diameter by 12 inches stroke.

One sanitary pump of the vertical simplex type, having cylinders 8 inches and 8 inches diameter by 12 inches stroke.

One ash ejector pump of the vertical duplex type, having cylinders 14 inches and 8½ inches diameter by 12 inches stroke.

One fresh-water pump of the vertical simplex type, having cylinders 4½ inches and 6 inches diameter by 6 inches stroke.

One auxiliary condenser having 925 square feet of cooling surface, with an independent vertical simplex air pump with cylinders 7½ inches and 14 inches diameter by 10 inches stroke, and an independent centrifugal circulating pump having 6-inch nozzles and driven by a 6-inch by 6-inch steam engine.

Two multi-coil evaporators, having a total capacity of 8,000 gallons per 24 hours and fitted with an independent vertical simplex 4½-inch by 6-inch by 6-inch feed pump.

Two multi-coil distillers having a total capacity of 4,000 gallons per 24 hours and fitted with an independent vertical simplex, 8-inch by 8-inch by 12-inch circulating pump.

One multi-coil feed-water heater and a cartridge grease extractor having 5-inch diameter connections.

One vertical donkey boiler, 7 feet diameter by 11 feet high, built for 200 pounds per square inch working pressure and fitted with a vertical simplex, 6-inch by 4-inch by 8-inch feed pump.

Two vertical duplex cargo oil pumps located in the pump room forward, having cylinders 14 inches and 12 inches diameter by 18 inches stroke.

One two-ton capacity refrigerating plant for the ship's stores, fitted with a 9-can ice-making set.

Two 25-kilowatt turbo-generating sets, located in the dynamo room.

All of the pumps enumerated above were supplied by the Warren Steam Pump Company, Warren, Mass. The evaporators, distillers and feed-water heaters were manufactured by the Griscom-Russell Company, New York. The refrigerating plant was furnished by the Brunswick Refrigerating Company, New Brunswick, N. J., and the electric generating sets were furnished by the B. F. Sturtevant Company, Hyde Park, Mass.

The keel of the *Ulysses* was laid on May 19, 1914; she was launched on December 12, 1914, and her trials were held on April 14 and 15, 1915. The keel of the *Achilles* was laid on May 21, 1914; she was launched on February 6, 1915, and her trials were held on June 8 and 9, 1915. The contract date for delivery of the vessels was August 9, 1915; the actual date of delivery of the *Ulysses* was April 17, 1915, and of the *Achilles,* June 10, 1915.

On her standardization trial over the Delaware Breakwater course the *Achilles* made an average speed of 15.23 knots for the high-speed runs, and an average of 14.281 knots for the 24-hour endurance run at sea. This speed could have been exceeded on the endurance run, but for reasons of economy it was kept down to this figure. The average of the *Ulysses* over the standardization course was 14.99 knots. The trials were carried out with the ves-

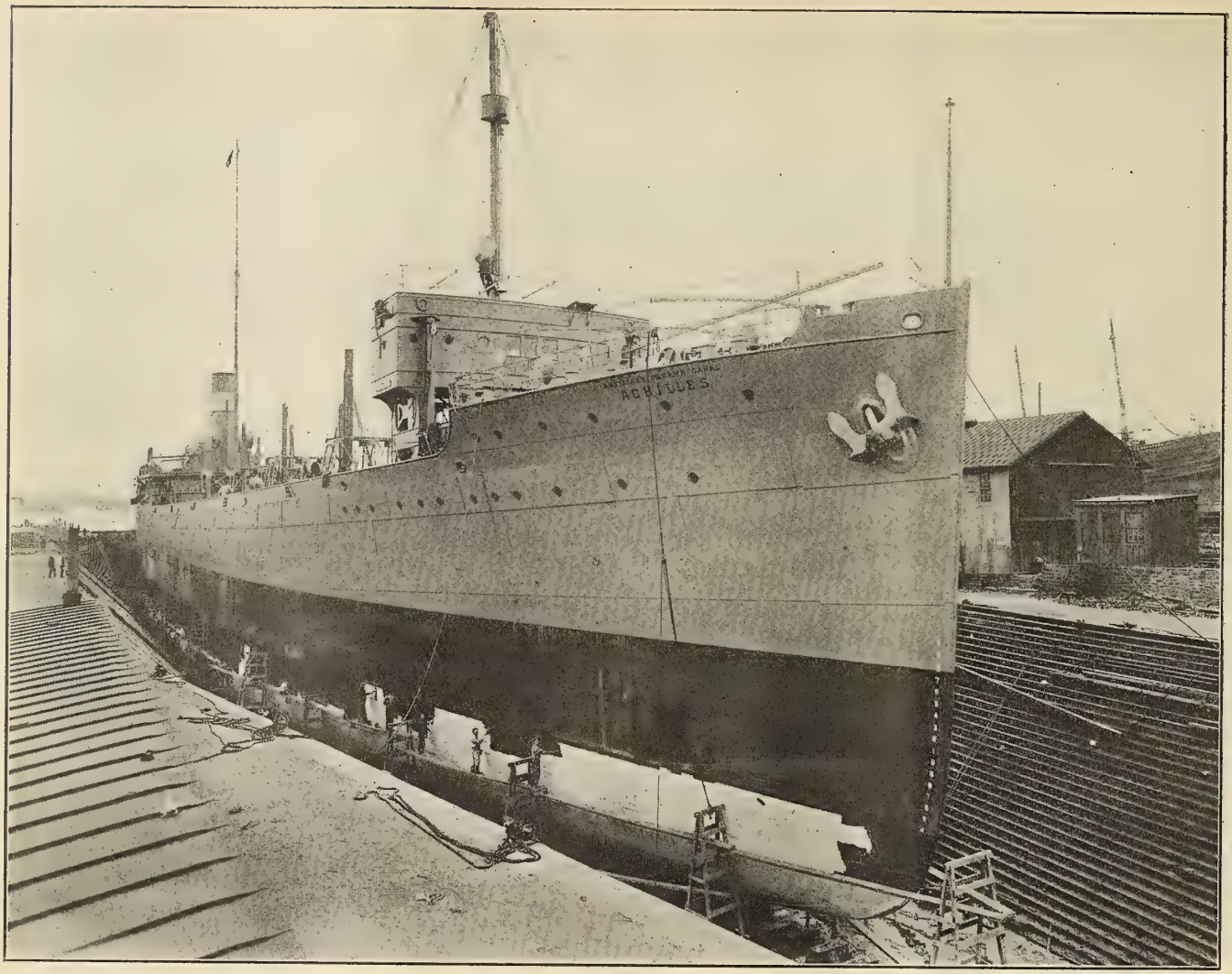


Fig. 6.—Panama Collier *Achilles* Being Cleaned and Painted in the Upper Dock of the Baltimore Dry Docks & Shipbuilding Company

sels loaded with 13,305 tons of deadweight on the load draft.

Each vessel was delivered to the Panama Canal authorities within twenty-four hours after the completion of the trials, and sailed on the first voyage within forty-eight hours of the finish of the trials, which establishes another world's record for the Maryland Steel Company, the builders of the vessel.

Regulations for Oil Burning Vessels

Amendments to the rules and regulations relating to the installation of fuel oil tanks on steamers and to applications for permission to use petroleum as fuel on ships have been adopted by the Board of Supervising Inspectors of the United States Steamboat Inspection Service. Greater discretion has been given to the respective inspectors of the districts in deciding how the tanks shall be installed on ocean steamers, and it is ordered that an application for permission to use petroleum as fuel must be made in duplicate to the supervising inspector of the district in which the vessel is at the time she is equipped for that purpose.

In revising the rules that govern oil burning ships the board struck out an entire section, including more than a page of specific instructions on the building of tanks to be used on ocean and coastwise vessels. A new provision extended to ocean shipping the more general provision that has heretofore applied to shipping on lakes, bays, sounds and rivers. It added for each of these classes of ships the provision that application must be made in the way specially prescribed for permission to use oil fuel. The new provision for ocean or inland steamers reads:

"The fuel oil tanks on all (ocean or inland) steamers, subject to the rules and regulations of the Steamboat Inspection Service, shall be constructed of material of such thickness and workmanship as, in the judgment of the inspector in whose district the installation is made, is safe.

"Application for permission to use petroleum as fuel must be made in duplicate to the supervising inspector of the district in which the vessel is at the time she is equipped to use oil as fuel. Application to use petroleum as fuel must be made on the blanks furnished for that purpose. Two blueprints or tracings showing the proposed installation of the tanks, pumps, piping, valves and burners must accompany the application."

MERCHANT SHIPPING.—After extended investigation the National Foreign Trade Council, in a statement submitted to Congress on May 17, pointed out that to increase the 14.3 percent of American foreign commerce carried by American ships in 1915, to 60 percent ten or fifteen years hence, would require from 6,000,000 to 10,000,000 gross tons of steamers, worth over one-half a billion dollars at the least.

Fig. 1.—Government Survey Steamer *General C. B. Sears*

Harbor Survey Boat General C. B. Sears

Government Vessel Built on the Great Lakes by Army Engineers for Harbor Improvement Service

A STEEL survey boat of 296 tons displacement, capable of a speed of 12 miles per hour, has recently been completed at Muskegon, Mich., for the Duluth (Minn.) United States Engineer District for service in improving the harbors on the Great Lakes. The contract for the construction of this boat was awarded to the Racine Trustcott Hull Lake Boat Company, Muskegon, Mich., but owing to the failure of this concern while the hull was still on the stocks, the plant of the contractor was taken over by the United States engineers and the boat was completed under the direction of the Engineers' office.

The boat is propelled by a single screw driven at 118 revolvutions per minute by a compound surface condensing engine built by the Spedden Shipbuilding Company, Baltimore, Md. The pumps were supplied by the M. F. Davidson Company, New York. A full surface condensing equipment was installed in order that the boat could be transferred for duty in salt water if required.

The principal dimensions of the hull are as follows:

Length over all	110 feet 7¼ inches
Length between perpendiculars	105 feet 7¼ inches
Beam, molded	22 feet
Depth, molded	12 feet
Draft, forward, approximate	8 feet 6 inches
Draft, aft, approximate	10 feet 6 inches
Displacement, approximate	296 long tons

As can be seen from the general plans, the vessel has an enclosed forecastle. This feature was found to be an advantage, as during a run in Lake Erie in the teeth of a gale solid water reached the level of the forecastle deck without wetting the forecastle and main decks. In this case the seas were short, about the length of the hull.

Spacious quarters for the officers and crew are conveniently located, as shown on the general arrangement plan. The life-saving equipment consists of a 16-foot metallic lifeboat and a life raft with a capacity for ten persons. The vessel is heated throughout by steam and lighted by electricity, a 5 kilowatt 110-volt turbo generator being installed in the engine room.

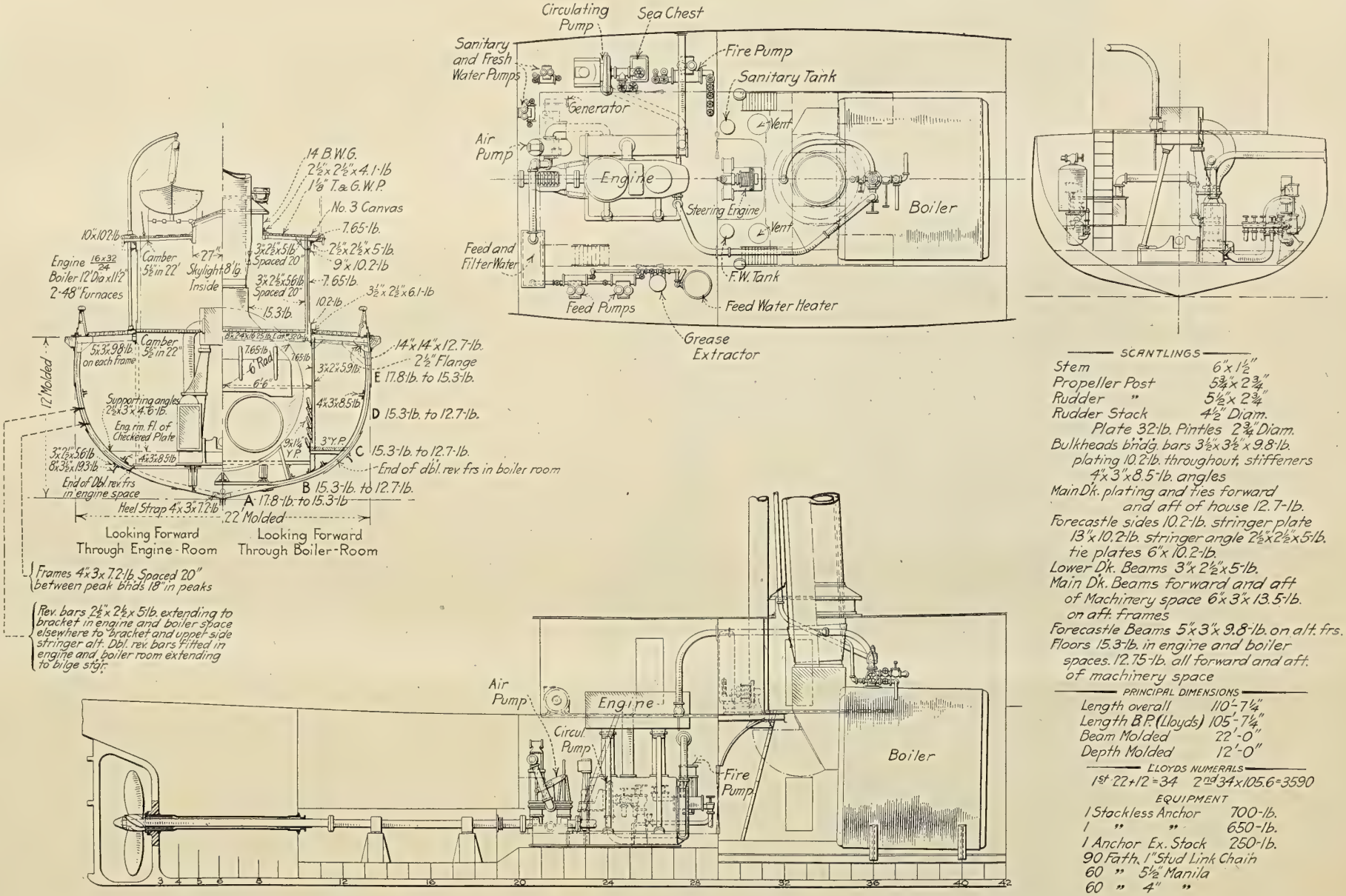
Propulsion is by a single screw driven by a vertical-inverted, direct-acting open frame surface condensing fore-and-aft compound engine designed to operate at a speed of 125 revolutions per minute with a working steam pressure at the boilers of 150 pounds per square inch. The cylinders of the engine are 16 inches and 32 inches diameter by 24 inches stroke.

The high-pressure valve is of the piston type, the low pressure valve a double ported slide valve. The valves are operated by double eccentric through Stevenson link motion. The low pressure steam chest is provided with a balanced cylinder cast on the cover with a bore of about 6 inches diameter.

The cylinders are supported at the back by two cast iron columns of box section and at the front by two steel turned columns tapering from 4 inches diameter at the head to 4½ inches diameter at the foot.

The reversing gear is direct acting, having a steam cylinder 6 inches diameter by 9 inches stroke directly connected to the reversed shaft by a lever with control gear to prevent slamming.

The crank shaft is of the solid forged type of steel 7½ inches diameter with main bearing surfaces 5¾ inches long. The crank pins are 7½ inches in diameter and 8½ inches long. The cranks are set at angles of 90 degrees to each other. The thrust shaft is of forged steel 7¼



SCANTLINGS

Stem	6"x1½"
Propeller Post	5¾"x2¾"
Rudder "	5½"x2¾"
Rudder Stock	4½" Diam.

Plate 32-lb. Pintles 2¾" Diam.
Bulkheads bhd'g. bars 3½"x3½"x9.8-lb. plating 10.2-lb. throughout, stiffeners 4"x3"x8.5-lb. angles
Main Dk. plating and ties forward and aft of house 12.7-lb.
Forecastle sides 10.2-lb. stringer plate 13"x10.2-lb. stringer angle 2½"x2½"x5-lb. tie plates 6"x10.2-lb.
Lower Dk. Beams 3"x2½"x5-lb.
Main Dk. Beams forward and aft of Machinery space 6"x3"x13.5-lb. on aft. frames
Forecastle Beams 5"x3"x9.8-lb. on alt. frs.
Floors 15.3-lb. in engine and boiler spaces. 12.75-lb. all forward and aft. of machinery space

PRINCIPAL DIMENSIONS

Length overall	110'-7¼"
Length B.P. (Lloyds)	105'-7¼"
Beam Molded	22'-0"
Depth Molded	12'-0"

LLOYDS NUMERALS

1st 22+12=34 2nd 34x105.6=3590

EQUIPMENT

1 Stockless Anchor	700-lb.
1 " "	650-lb.
1 Anchor Ex. Stock	250-lb.
90 Fath. 1" Stud Link Chain	
60 " 5½" Manila	
60 " 4" "	

Fig. 2.—General Machinery Arrangement, S. S. *General C. B. Sears*

inches diameter provided with six 1⅛-inch thrust collars forged on. The thrust bearing is of the usual horseshoe type. The tail shaft is in one piece 7¾ inches diameter.

The propeller is four-bladed of cast steel with a diameter of 8 feet and a pitch of 11 feet 9 inches.

The main condenser, which is located under the back columns of the engine, has a cooling surface of 650 square feet. The shell is of cast iron and the tubes of brass ¾-inch outside diameter of No. 18 B. W. G. tinned outside and inside. The air pump is of the vertical, simplex, twin beam, single acting type, having one 7-inch diameter, double acting, inverted steam cylinder and two 12-inch diameter single acting air cylinders, all having a common stroke of 12 inches. The circulating pump is of the centrifugal type with an 8-inch suction and a 6-inch discharge direct connected to a 4½-inch by 4-inch vertical engine. All of the pumps on this vessel were supplied by the M. T. Davidson Company, New York. They include the following, in addition to those already described:

One vertical duplex fire deck and bilge pump with 7½-inch steam cylinders, 3¼-inch water cylinders and 7-inch stroke.

Two vertical duplex boiler feed pumps of the pot valve type with 5½-inch steam cylinders, 3½-inch water cylinders and 6-inch stroke.

One vertical duplex fresh water pump with 3-inch steam cylinders, 3-inch water cylinders and 3-inch stroke.

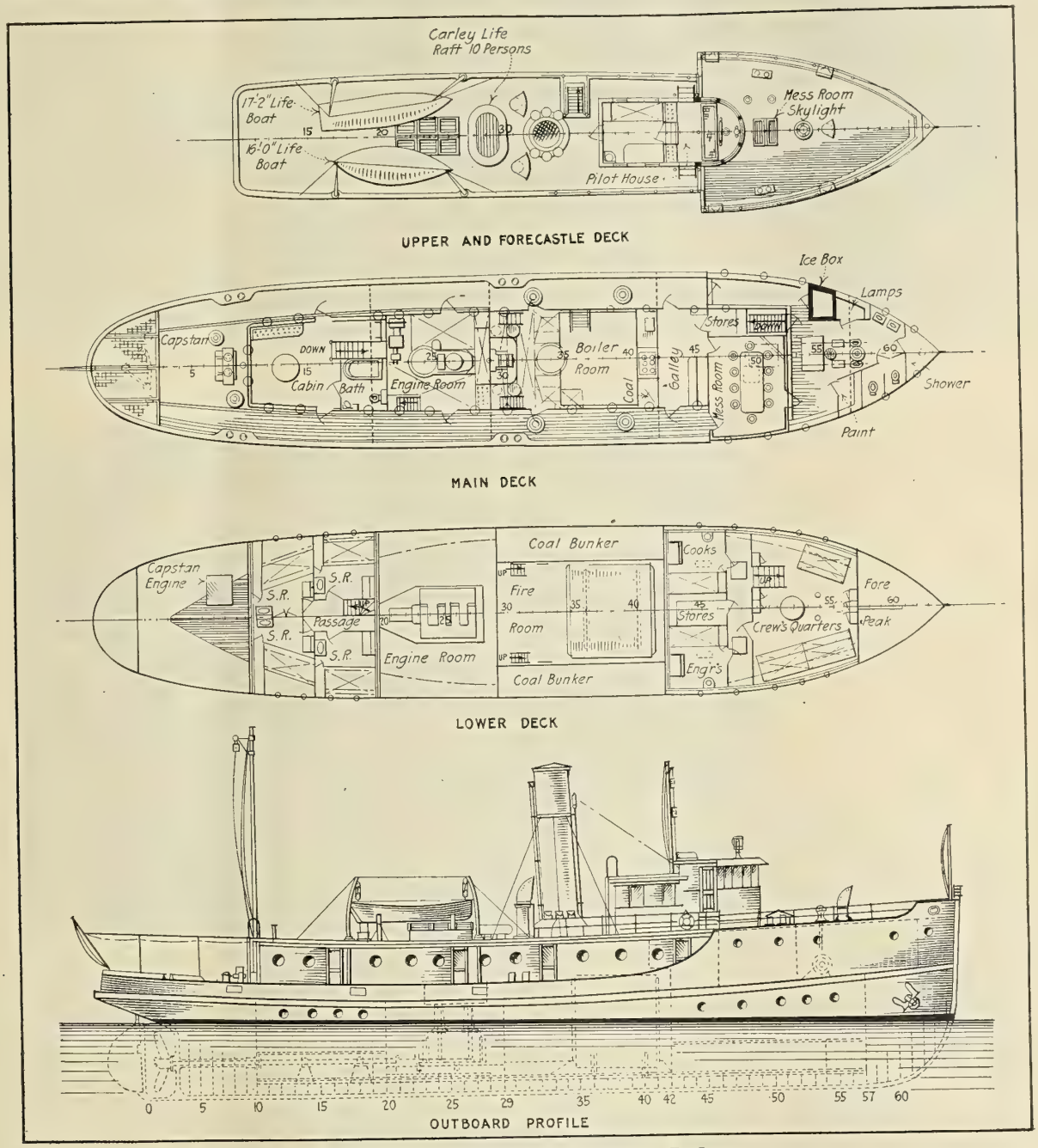
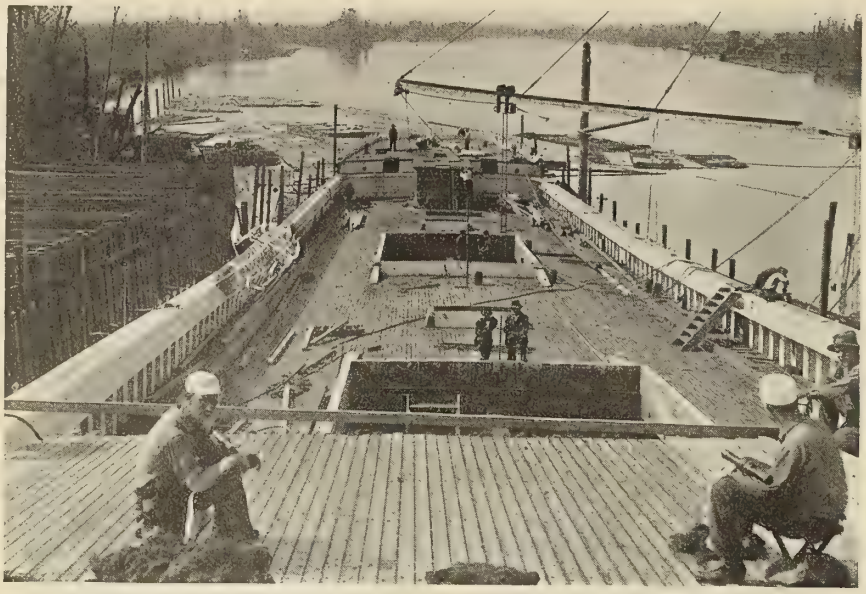


Fig. 3.—Harbor Survey Steamer *General C. B. Sears*

One vertical duplex sanitary pump with 4-inch steam cylinders, 2¾-inch water cylinders and 4-inch stroke.

A feed water heater of the multicoil type is installed in the auxiliary exhaust line.

Steam is supplied at a working pressure of 150 pounds per square inch by a single cylindrical return tube single end boiler, having 1,454 square feet of heating surface and 54 square feet of grate surface. The boiler is 12 feet in diameter by 11 feet 2 inches long, with two Morison corrugated furnaces, 8 inches inside diameter.



Deck of Auxiliary Motor Ship *City of Portland*, as Seen from the Forecastle

View of the Hold, Showing Truss Construction

Auxiliary Motor Ship City of Portland

Wooden Sailing Vessel Built for the Lumber Trade Fitted with Bolinder Oil Engines for Auxiliary Power

BY KENNETH MC ALPIN

During the early part of the war shipping along the Pacific coast took a decided jump and all along the coast the harbors were combed for any and all seaworthy bottoms to be placed in the offshore trade. As the war progressed and the destruction of neutral vessels shortened the available tonnage, the lumbermen in the Northwest began to suffer, for while there was more call for lumber than during the three years immediately preceding the war there was no chance to transport the lumber even at high charter rates owing to the shortage of vessels. It was a happy idea which entered the heads of various coast lumbermen that a wooden vessel provided with sails and a low cost engine would not only obtain high charter rates for cargo but would provide a means of sale for the lumber and would also be the means of building the vessel economically.

Launching of the *City of Portland*

The *City of Portland,* launched at the plant of the St. Helens Shipbuilding Company, St. Helens, Ore., on April 15, therefore marks an epoch in ship construction, as she is the first American built and the largest wooden auxiliary cargo carrier in the world. Her dimensions, as entered in the United States Custom House at Portland, Ore., which is her home port, are as follows: length, 278 feet; beam, 48 feet 3 inches; depth, 19 feet 1 inch; gross tonnage, 1,791, and net tonnage, 1,649.

The *City of Portland* made such a good impression on the surveyors of the Bureau Veritas and the Fireman's Fund Insurance Company that the day she was measured she was immediately classed as A1 for eleven years and insurance may be carried on her for that length of time and longer if ordinary maintenance repairs are made upon her.

Looking forward from the after end where the engines are being installed one is impressed by the amount of stowage room afforded by the truss type of construction used, in which a heavy fore and aft timber and steel

Vessel on the Stocks Before Launching, Showing Location of Propellers

truss, extending from stem to stern and from the keelsons to the single deck, reinforces the hull without interfering with the handling and stowage of lumber. A steel bulkhead divides the cargo hold from the engine room and further strengthens the vessel.

The best of timbers and lumber were used in the construction, and some of the longest single timbers ever used in vessel construction make up a part of this vessel. Some of the lower timbers were sawed one hundred and forty feet long and over twenty-four inches square. From the top of the keelson timbers to the botom of the keel is an even eight feet of heavy timbers, most of them 20 inches by 24 inches in size, and a section from inside to the outside of the vessel through a frame gives an average thickness of 2 feet of solid wood, the planking being 5 inches by 8 inches and the ceiling 16-inch material. With trifling exceptions the vessel is constructed throughout of Oregon fir, two million feet being used in its makeup. Probably nowhere else in the United States save in the Northwest on the Pacific coast could such wonderful timbers be obtained. The masts, for instance, are typical Oregon poles, the tallest being one hundred and thirty-six feet long and thirty inches thick at the base, swelling a bit above the base. This is the foremast, while the three center masts are about the same height, but with a thickness of forty inches at the base. The fifth mast is almost the same size as the rest, and all booms, etc., are of the same Oregon fir. The bowsprit is one piece of timber tapering from a square butt of nearly thirty inches to ten inches at the extreme end. A feature of this boat probably not seen in another ship of her size is a 14-inch slot in the center of the base of the masts, extending from the keelson to the deck to accommodate the reinforcing truss. The masts, spars, booms, etc., were all shaped and finished in the shipyard.

The *City of Portland* has a deep well deck, which will accommodate slightly over one-half of her two million feet capacity cargo of lumber, the balance being loaded below below decks in her spacious hold. The crew's quarters are located in the forecastle, and the comfortable quarters for the captain and officers, as well as the galley and dining saloon, are located in the stern, with an enclosed 8-foot by 12-foot wheel house surmounting the cabin. The captain's quarters consist of a bedroom, living room and bath, while on the other side of the main dining saloon are located the quarters of the three officers and chief engineer with a bathroom between them. The galley is situated so as to serve the main dining saloon and the sailors' mess with the greatest convenience.

This vessel will carry a 7,000 square yard spread of canvas, which will drive the ship at an estimated speed of nine miles an hour, and has as auxiliary power two 4-cylinder Bolinder type semi-Diesel engines, each unit developing 320 horsepower at 225 revolutions per minute and swinging a four-blade propeller 77 inches in diameter and 61 inches pitch. These engines will consume about a barrel of fuel oil per hour, or an estimated consumption of 26 barrels per 24 hours, and will drive the vessel at 7½ or 8 knots, so that the total time of the trip to Sydney, Australia, from the Columbia River will be approximately 28 days. The great saving in cargo space is emphasized by the fact that these engines will take up only 4 percent of the cargo space against 40 percent for steam engines of the same power.

The fuel tanks for the engines are placed alongside the engines and have a total capacity of 1,200 barrels of oil, which provides for a cruising radius of 6,000 miles. In the extreme after end of the boat are two fresh water tanks with a total capacity of 10,000 gallons.

In addition to the propelling engine, the *City of Portland* will have one 66-inch dry back marine boiler which will drive the steam anchor hoist, steam capstan, four double hoist winches and steam bilge pump and will also drive the electric light dynamo when in port.

For the loading and storage of cargo two pairs of cargo booms are provided, one pair on the foremast serving an 18 by 26-foot hatch and one pair on the spanker mast serving a similar hatch forward of this mast. These will enable the vessel to be unloaded from either or both sides at one time, the booms being driven by a separate double winch for each boom. This will greatly facilitate the quick despatch of the vessel, and as cargo space is the greatest need they will not interfere with the sixteen-foot deckload of lumber she will carry.

The vessel will present a very pretty picture under sail, as she is of the bald head schooner rig type and will in a way placate the old seamen who have witnessed the gradual withdrawal of the "windjammers." On the other hand, she will be given even the admiration of the "men in steam" as she carries out their theory as to low cost propulsion and operation.

The *City of Portland* will probably leave for Sydney about June 15 with a cargo of lumber and has been chartered for three trips at high charter rates. She will bring on each return trip a capacity cargo of three thousand tons of coal or general cargo. She has been paced under the command of Captain Olaf Johnson, who has been with the McCormick Company in steam for a long period of time, and previous to that was probably known to marine people in all parts of the world, as he sailed for the Knowland Company in San Francisco for twenty-six years.

The *City of Portland*, as well as three more sister ships which differ but slightly, was designed and built under the direction of Mr. J. H. Price, naval architect, and the details of the management of the vessel are under the authority of Mr. Hewett, port superintendent of the Charles R. McCormick Company of San Francisco, Cal.

The three sister ships of this vessel are now on the ways at St. Helens, as well as two smaller ships for an Alabama firm. A total of twenty-five similar ships are under way at various yards in the Pacific Northwest, and inquiries have come in from Manila, P. I., and as far away as Norway and Sweden in regard to contracts for same.

The total cost of the *City of Portland* will be approximately $175,000 (£36,000).

DUCTILITY OF BARS FOR STAYS AND BRACES IN MARINE BOILERS.—A recent amendment to the Rules and Regulations of the United States Steamboat Inspection Service provides that when the tensile strength of the test piece of bars for stays and braces in marine boilers is more than 63,000 pounds per square inch of section, each test piece that has been reduced in size shall show an elongation of at least 26 percent in 2 inches.

UNITED STATES COLLIER TO BE FITTED WITH DIESEL ENGINES.—The United States collier *Maumee* arrived at the New York Navy Yard, Brooklyn, N. Y., on April 3, having been towed by the United States collier *Prometheus* from the Mare Island Navy Yard, San Francisco, Cal., where she was built, a distance of about 4,000 miles.

The engines for the *Maumee* were built at the New York Navy Yard from plans supplied by the New London Ship and Engine Company, Groton, Conn. Preliminary shop tests of the engines have already been made, and as soon as they have been installed in the vessel an exhaustive series of trials will be carried out at sea.

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Reference Library of Naval Architecture

The data and information on naval architecture and allied subjects which are published in periodicals and proceedings of professional societies are of such importance that the engineering department of a shipbuilding concern cannot afford to neglect them; but, on the other hand, there is so much of this material that it is of little value unless readily referred to.

The material to be handled in a reference library naturally comes under two heads; namely, articles, papers, and books in one's possession and those which must be referred to at libraries, etc. Under the first head come such professional magazines as one subscribes to regularly.

DESIGN (Ship)
Calculations for ships forms. D. W. Taylor. Paper before Int. Eng. Congress. Application of formulas. 3000. P-1, IME, 10-15.

Steamship design. Method of determining principal dimensions. H. A. Everett. 4p. IME, 10-15.

Geometrical processes for design of ships framework. Table & plates. W. Engelhardt. ill. 1500. Sch. 11-10-15.

Specimen Card

These should be bound or they will be of little value for reference work. Books and pamphlets should of course also be kept in the handy library with the bound volumes of periodicals. Often one may obtain clippings from other magazines, photographs, sketches, etc., from miscellaneous sources which it is desirable to file. These should be pasted in a good sized loose leaf scrap book in order to preserve them neatly.

The next thing to consider is how to have all the information in these volumes at one's finger's tips. The best index to use for this purpose I have found to be a card index. Three-inch by 5-inch white cards are convenient. Besides the regular alphabetical stops, blank stops should be obtained and labeled with the important topics under the subject of naval architecture and shipbuilding, as Accidents, Armor, Barges, Battleships, Boilers, Cargo Ships, etc. I have been using a typewriter to fill in the index cards, but they can of course also be written or lettered in ink, although this detracts somewhat from their neatness and legibility. A certain article may be entered on a card under a topic and then later another paper on the same topic may be entered on the same card. (See specimen card.) The index card should indicate the following facts about the article or book: Title, author, nature of article, whether illustrated, date, length, where found. In order to get these facts into a few lines on the cards a system of abbreviations should be adopted. Some articles of particular importance require indexing under two topics, as

Description of U. S. Collier "Jupiter"—under Collier, and under Propulsion, Electric.

The above deals only with material in one's own library. This is naturally most referred to and most important, but there are also many articles published which one cannot or does not care to read or consult at the time of publication, but which one may wish to refer to later. The American *Engineering Magazine* publishes monthly a comprehensive list of articles on naval architecture and marine enginering which have appeared in all the world's important periodicals for the past month. This resumé gives the topic under which the article comes, the title, subject matter, author, length (number of words), whether illustrated and where found. An excellent system of abbreviafions is used. I have found it convenient to index these papers and articles in my card index under the same topics, but on *blue* cards, in order to distinguish when referring to the index betwen information which is at hand and that which must be obtained at a public or private library. The resumé will mention the important articles in some of the periodicals which one receives regularly, hence care must be taken not to enter these items on blue cards. The *Engineering Magazine* also publishes this resumé printed on one side of the paper only, so that the items may be clipped and pasted on index cards. It is also important to index books and pamphlets as they are published, and this may be accomplished by consulting the book reviews.

The method of indexing outlined above I have found very simple and useful. It requires only a few hours a month to keep it up to date, and designers and writers on naval architecture and shipbuilding will find it well worth while.

JOHN K. CHRISTMAS.

Easton, Pa.

Classification and Filing of Engineering Data

I note with interest the paragraph in the April number of MARINE ENGINEERING on "Classification and Filing of Engineering Data." So far as I am aware your publication is the only one that has gone so far as to suggest such coöperation. It is to be hoped that the readers and subscribers will respond.

This classifying and filing of engineering literature has been food for much discussion. I have been investigating this field for some time in an attempt to boil down from the many articles appearing in books and society proceedings, to say nothing of periodical references, something which shall aim to be exactly what the results of the suggestions in this article should arrive at, to put in a compilation I am working on for the use of business men and business house libraries.

Of the best articles to be had are those found in Davies' new book on "Engineering Office Systems" and Hauer "Economics of Contracting." Volume 2.

To-day, and for the future, the matter of working out a satisfactory index, and as near an approach to standard

treatment as is possible, is reduced in its magnitude by the presence of so-called special libraries. In these libraries, frequently in charge of specially trained persons, the administrators of these collections have been giving considerable attention and study to this very subject of "Classification and Filing of Engineering Data." That they have solved many difficulties and the experience of these people is of value in this proposed co-ordinating of the classification and filing of engineering literature, goes without saying. In fact these librarians, as they are called, have formed an association for the promotion of efficient administration of engineering collections and allied matters. This association has been organized for five years. It has in its membership some three hundred and fifty odd members representing individuals of repute and firms of high standing, both in this country and several foreign countries. The members of this association, known as the Special Libraries Association, might logically form a committee which shall undertake to analyze the results of the proposed study of classification and

File No. Subject Title

Author
Periodical Date. pages.

Arrangement of Index Card

filing of engineering data for the purpose of submitting, if not standard methods for handling engineering data, at least rational and recognized methods as represented by the light of prolonged study on the part of these specialist librarians in their particular fields.

Such coöperation may be well in the future and possibly such standards as might be proposed would not be universally adaptable. However, I believe it would be worth while working out and the final results printed in some manner, forming thereby a suitable guide for the engineer without the special library at his elbow, and something on which the individual engineer with small office force may found an office "Handbook," which is really what these special libraries are.

In writing the above I had in mind the process carried out by a firm in indexing periodical literature of interest to them. The originator of the idea uses a series of headings, which are in fact nothing more than a skeleton outline classification, and assigns related numbers. Upon finding an article which it is desired to preserve, the person writes in the margin the number corresponding to the subject. The article is then passed on to a clerk, who copies the title under a proper subject suggested by the classification number. This method serves a double purpose (1) of assigning a classification number, or more commonly spoken of outside of libraries, as an index or file number, and (2) a proper reference heading.

For example, supposing you see in a magazine an article on "Marine Steam Turbines." Supposing your classification number or file number is 621.123. You then mark the article 621.123 and place it in the hands of clerk to be written up. The clerk then looks in his index for the translation of 621.123 and finds it means "Turbines, Marine," or "Marine Turbines," whichever form of entry you prefer. The clerk then writes a card with the heading "Turbines, Marine," which would be the more logical as, perforce, in a shipyard all matter is essentially marine. After writing the heading, the clerk copies the title of the article and author, if there is one, just as though he were transcribing it into a letter. Following after that the usual information as to volume and its number and page, etc.

With a form card as suggested it is not a very brainy matter to index periodical literature—or book literature, for that matter.

In reading over some of the many articles on the subject of indexing and filing engineering literature I find that many engineers are making considerable effort in overcoming the difficulty of what headings to use and how to keep those headings uniform. There are at present two possible aids that to me would tend to overcome that difficulty. I have in mind the American Library Association's "List of Subject Headings" and the Library of Congress "List of Subject Headings"—the latter more adaptable to special technical subjects.

In both of these compilations are listed thousands of subject headings found to be suitable for the indexing, or what we call "subject heading" of literature. It does not matter whether these lists were primarily gotten up for libraries because libraries relate largely to books. The subject of a thing is the same whether it is a book, pamphlet, periodical or engineer's note. Experts in their lines have worked on the proper form of entry and wording for these headings. They have worked to make a uniform set of headings. While in many instances they are inadequate for specific divisions of engineering they are not, on the other hand, absolute. The idea of getting up these lists was for uniformity and guidance—something on which to build. The practice in libraries is to use these as guides and modify where needed, and space is left for making suitable notes.

The librarian of H. M. Byllesby, of Chicago, says: "One fundamental and important fact seems to have been omitted in the majority of articles written by engineers upon the subject (indexing), namely, the fact of standardization of library methods for handling library material. Standardization rules have been adopted in practically all lines of engineering, but the engineering profession in general has not been informed that library methods have also been standardized by library experts, and that the vexing problems which they are endeavoring to individually work out, as indicated by the variety of experiments which are written up from time to time, have been tried out, solved and reduced to a working science by library experts."

While I think that the above is rather sweeping, I nevertheless am convinced that by coöperation both sides can gain in reducing the element of handling and filing engineering data to a science. One instance I noted in the reading of these articles that leads me to believe there is an element of truth in Miss Krause's statement, that is, of all the articles I have read only two men had hit upon the idea of indicating on the original, or what we call "Main Card," all other cards made out. So when the publication is removed all cards are taken out and not a lot of dead ones left in, as so many of the engineers claimed. Now, in library work the indicating or "tracing" all cards made for a publication is as old as the card index. By the way, it is interesting to note that a librarian was the originator of the card index.

If you are not already acquainted with the Industrial Arts Index, I believe that publication is an aid in handling engineering literature for all headings that titles are

indexed under might serve as a subject heading list, and the chances are that terms used in it are more universal. In fact, where an office is limited to one subject practically, it would be better than nothing to simply cut out the references of most interest and paste on index card and file alphabetically or by classified order. However, the references would be old, for the publication is issued quarterly.

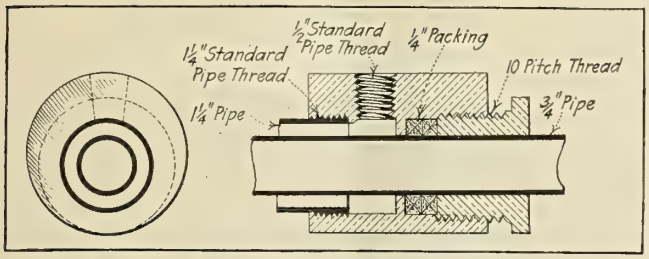
I hope to see this step inaugurated by your publication the means of bringing whatever is of value in library science and service to the service of engineers.

Kenneth C. Walker,
Head Department of Technology.
Free Public Library, New Haven, Conn.

Feed Heaters for Small Boats

Some time ago the question of feed heaters for small boats came under discussion. Now as these boats were in constant use and the coal capacity of the boats is limited, it was considered that it would be a good plan to install heaters, but as no heaters of proper size were found in the market one of the following description was built and installed in each of this ship's boats.

After some study on the subject this type was built. A section of ¾-inch pipe, just a little longer than the width of the boiler, was threaded on each end. Over this was passed a section of 1¼-inch pipe, which gave a clearance of approximately 5-32-inch around between the pipes as the ¾-inch pipe was 5-16-inch smaller in diameter than the inside of 1¼-inch pipe. The 1¼-inch pipe was cut



Sketch of Special Fitting for Feed Water Heater

somewhat shorter than the ¾-inch pipe and was threaded to receive fittings.

Special fittings were machined by the ship's force to conform with the sketch. These were then screwed, one on each end of the 1¼-inch pipe, and glands were packed, after which a tee was fitted on each end and connections were made from tees to the boiler checks and to the feed pumps. Valves were placed on the pump discharge at the pumps, so that when the starboard pump was in use the discharge valve on the port pump was closed and the feed stop on the starboard was also shut. The water from the starboard pump was then discharged through the heater and into the boiler through the port feed check and stop. When the port pump is to be used, the valves were worked just the revese.

After the water connections were made the exhaust of both pumps was connected to one of the special fittings and drains were piped from special fittings on the other end. On this drain line a relief valve was placed and set at about 4 pounds, after which the drains were piped to the engine drain line to the condenser. On this line was placed a valve so that the drains could be run into the bilge in case the boat was in the skids and it was not desired to run the drains into the condenser for the time being.

As no time was to be had for experimenting, full data cannot be given, but such data will be taken and the results will be announced later.

The following facts have been noted since the heaters have been installed:

(a) The amount of coal used has been reduced by about 18 percent.

(b) The grate bars do not burn out or sag as they would under a heavy fire, as a light fire has proven to be hot enough.

(c) The use of a steam jet is not needed nor resorted to to maintin the steam pressure.

(d) The engine seems to run smoother as a steady pressure is maintained.

As the volume of exhaust steam and volume of water to be heated are always in same ratio, the water is heated to the same temperature at all times, varying only as the temperature of the air pump discharge.

F. C. W.

An Expensive Error of Judgment

A peculiar accident, that caused considerable delay and expense to the owners, occurred to a steamer engaged in the coastwise lumber carrying trade. This steamer had a triple expansion engine, with a surface condenser built in the frame. On a recent voyage it was found that extra feed water was entering the boiler in such quantity as to necessitate frequent blowing down. The weather was bad and the chief engineer, supposing that the leakage was through the tubes in the condenser, decided to complete the voyage without stopping.

After some time a number of the tubes began to leak in the front end of the boiler, and about the same time some staybolts in the back connections started leaking. This caused a reduction of the steam pressure and consequent slowing of the engines, thereby delaying the completion of the voyage.

On arrival in port the boiler was emptied, when it was found in a deplorable condition. The engineers were surprised to find an extremely large quantity of grease in it, as well as a salt scale all over the heating surfaces. On testing the condenser by filling it with water a leak was discovered in the bottom of the shell at the low pressure crank pit. As this leak was in a place inaccessible for repair from the outside it was decided to remove the tubes in order to locate and patch it on the inside. On doing so it was found that instead of a damaged shell a drain pipe from the bottom of the shell had corroded away and grease and salt water from the bilges and crank pit had been entering the condenser through the hole. The ship had a list to port all the way up the coast and the hole was sealed by the water in the bilges, so that there was no loss of vacuum, thus accounting for the natural supposition of the engineers that the leakage was through the tubes. Had they supposed that the leakage was through the shell they would have stopped and made temporary repairs, even in the bad weather that prevailed.

Almost four weeks' time was required to scale and clean the boiler and make repairs. Eight staybolts had to be renewed and the tubes in the boiler expanded, tubes removed and replaced in the condenser, in addition to the loss and inconvenience of the delay. Quite an expensive error of judgment!

This would seem to be one of those unusual experiences that prevent a marine engineer's life ever becoming monotonous.

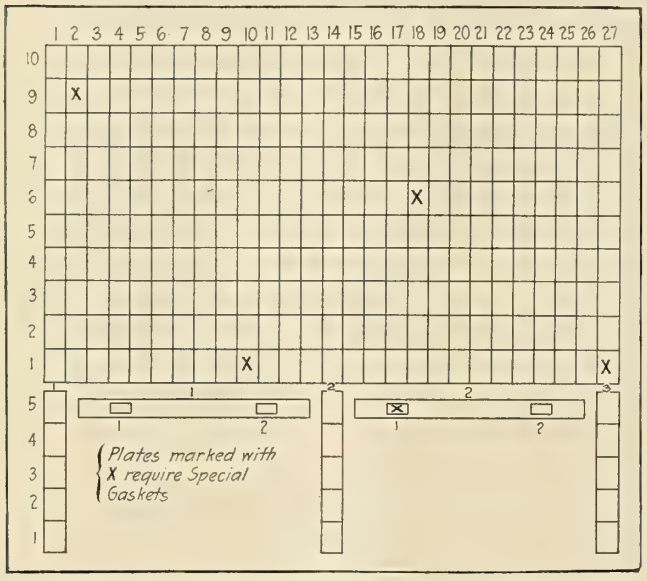
New London, Conn. J. S.

Graphic Record of Poor Header Seats in Sectional Type Boilers

Undoubtedly there are many engineers who have had unpleasant troubles with header handhole gaskets blowing out, the attendant necessity of hauling hot fires and we all would welcome some way to prevent this or reduce it to a rare occurrence.

Gaskets blow out from many causes, such as being improperly placed on the plate seat, not set up tight or not followed up on when the boiler becomes heated. But more often the trouble is due to the seats in the headers being in bad or poor condition, rough and irregular, and in many cases worn and deteriorated away by leaking gaskets, so that in old boilers we have many troubles.

In the plant under my care there are sixteen, 27-header type, Babcock & Wilcox watertube boilers. All are over



Graphic Record Sheet for Header Seats, Boiler No. 1, Front

eleven years old and of course we have plenty of poor seats and headers. These are all located on a graphic record.

When it becomes necessary to clean the interior of the tubes we remove all the plates from the front headers, uprights and cross boxes, and from the two lower rows in the back headers. Our schedule of cleaning is to allow each boiler to steam on an average of 1,000 hours. This has meant that about every six weeks we have 8 boilers to clean and it is therefore necessary to remove and replace 2,784 handhole plates. In cleaning the boilers, removing and replacing the handhole plates, we have to use the firemen and coal passers, and of course all of them do not possess the ability to judge whether a seat in a header is poor enough to need a special gasket or attention, and in putting back plates they are liable to put in plates with common gaskets where ones of special make should be used. This is prevented if we know the location of all poor seats requiring special gaskets.

The graphic record is a plan of the boiler headers, uprights and cross boxes, as shown in the sketch. Each header and plate hole has a number, all being numbered from right to left and bottom to top, the same on each boiler. Now let us consider that we have just completed the cleaning of a boiler and closed it for testing. We fill it with *hot* water (this heats the gaskets and headers and they can be followed up) and we pump up the pressure, watching all plates for leaks. We find that some start leaking and will not make up tight, and perhaps we have some blowout. We mark all these, and empty the boiler, remove them and examine the plate, gasket and seat, and if we find that the seat needs a special gasket the location of it is at once placed on the graphic record of this boiler.

Now the distinct advantage of this method of recording these poor seats is that the next time this boiler is cleaned and is ready to have its plates replaced the graphic record is consulted and all poor seats are found by it and special gaskets placed on them by a competent man, and the firemen are then allowed to proceed closing all other plates. This method has saved the plant a great deal of time, trouble and expense, for even after many boilers were closed and tested with hot water up to the working pressure and all plates were found tight, we have had some gaskets blow out after the fires were lighted and steam pressure raised. Such plates as these were recorded and we now have nearly every poor seat in the boilers located and have seldom experienced the necessity of pulling a fire for a leaky gasket. This, of course, means saving coal and water.

For special gaskets, we use the regular handhole plate gasket wrapped with asbestos wicking soaked in red lead. If this sort fails to hold tight (which very seldom happens), we place a regular gasket on the plate and apply a thick coating of Smooth-on iron cement quickly and carefully place this in the header, set it up tight and bake it with a torch.

It has been my experience that with careful cleaning of the header seats and the application of a small wash of graphite paste one can preserve old header seats so they will last as long as the drum of the boiler will last.

C. H. W.

Analyzing a Marine Steam Plant*

The analysis of a steam plant begins with the selection of proper fuel, as outlined in the last issue. The next logical step is the proper use of this fuel. The analysis will be confined to the use of coal for the present, since the next letter is to be devoted exclusively to oil.

The fundamental principle of furnace design and proper combustion is that the air must pass through the combustion zone; not around it, or over it, nor under it, but through it. The combustion zone consists of two parts; they are the fuel bed and the flame space. The flame space is sometimes known as the combustion chamber. Hard coal requires very little flame space, because it has very little flame and such as there is exists mostly in the fuel bed. Soft coals require large flame space. There are two kinds of flame, that caused by the combustion of volatile products, which give a white flame, and that caused by the combustion of the gas, carbon mon-oxide, which gives a blue flame.

The process of combustion taken out of the text books and put into a Scotch boiler is about as follows with average coal. Suppose that we are dealing with an incandescent bed of fuel six inches deep, working at full load. Such a bed consists of pure carbon and ash, since all volatile hydrocarbons have been driven off, or the mass would not be incandescent. The air comes up through the grate bars and passes through the fuel, oxidizing the carbon, and thus creating heat. If plenty of air is going through, the products of combustion are carbon dioxide and other gases which we will consider later. If there is not enough air going through, as when the fuel bed is

*For previous letters on this subject see April and May issues.

too heavy or the draft is poor or the boiler is being crowded, carbon monoxide is formed, which means that the fuel is only half burned, and the monoxide gas will take fire and burn further if it finds air while it is hot. If a blue flame appears on the surface of the fire bed when the furnace doors, or the shutters in the door, are opened, it means that the fuel is not getting air enough. This can be remedied by increasing the draft or by admitting air above the bed through the fire door shutters.

When fresh coal is thrown in on the hot fire bed, the first action of the heat is to warm up the new coal. This distils off the volatile hydrocarbons or tars in the form of green smoke. These will burn if supplied with air above the fire bed, ignited by some of the fire bed left uncovered, or by white hot brick work. If, on the other hand, this vapor is kept cool by the iron sides of the furnace and does not meet an incandescence to ignite it, the calorific value of the volatile constituents will all be wasted in the form of dense volume of smoke up the stack. With a hard coal running 20 percent volatile matter, this loss would be immense, and with a soft coal running 35 percent volatile matter the losses would be so large that they would attract attention.

If too much air is admitted, another loss occurs which can be very large. No more air should be admitted than is necessary for combustion because it costs just as much to heat air as to heat water. To illustrate: Each pound of pure carbon requires about 12 pounds of air for its combustion. The calorific value of fuels is usually calculated by taking into consideration the amount of carbon and hydrogen contained, but this formula is disputed by some, and a much simpler one is as follows: The calorific value of pure oxygen is 7,760 British thermal units, no matter what it is burned with. Air consists of 23 percent of pure oxygen by weight. We know that it takes 8 pounds of oxygen or 36 pounds of air for each pound of hydrogen in the hydrocarbons of coal. We know that it takes 2 2-3 pounds of oxygen or 12 pounds of air for each pound of carbon in the fuel; therefore, after a glance at the chemical analysis of a fuel, arithmetic will give the theoretical amount of air required. Practically, from 12 to 12½ pounds of air are required for the combustion of average coal. One pound of air is about 12.4 cubic feet, or a total of about 150 cubic feet of air required for each pound of fuel. Air requires about one-quarter of the heat that water does to raise its temperature one degree. Suppose that there is twice as much air going through a furnace as should (there is often five or six times as much as should be). This air is discharged from the stack of a Scotch boiler at an average temperature of 1,000 degrees F. It may be taken from the fireroom at 100 degrees. This is a total rise of 900 degrees. For twelve pounds of air, this gives twelve times 900 times one quarter, or 2,700 British thermal units lost per pound of coal by admitting too much air. As the coal has a calorific value of, say, 11,000 British thermal units, the loss amounts to about 26 percent for every 100 percent of excess air, a prolific and common source of loss.

If it is desired to burn low-priced coals, which carry large percentages of ash and are of small sizes or full of dust, it is necessary that the boilers are not crowded; otherwise cleaning fires becomes such a burden and the condition of the firerooms so intolerable, that the men rebel, and their efficiency is lowered. It has been demonstrated time and again in all branches of industry that high-grade help well treated pays the best dividends. Ample boiler power lowers the rate of combustion and prevents the formation of unmanageable amounts of clinker on the grates.

If a great deal of soft coal is burned an arch of fire brick over the bridge wall will assist in keeping the green gases ignited and prevent smoke. It is also a good plan to line parts of the combustion chamber with brick for the same reason, but the brick should not be more than one thickness so that a portion of the heat may be transmitted through to the heating surface beneath and thus make use of the heating surface, as all marine boilers have a deficiency of heating surface compared to the load they carry. This system can hardly be applied to ferry steamers because the brick work retains so much heat that the boiler makes steam long after the fires are out.

The object of "working" a fire, breaking it up with slice bars, etc., is to prevent a solid bed forming which would prevent the air from passing through. This melting together is caused by two elements; first, the molten ash or slag which accumulates and tends to seal the air passages, and second the tarry constituents which tend to melt and flow before being evaporated, leaving the coke behind; therefore, a coal high in volatile matter and also high in ash will be hard to fire and tend to run together.

There are several ways of working fires. The most wasteful way and the hardest on firemen is simply to throw in coal regardless of other considerations. A better way is to shovel into the front of a furnace and shove the coal back after a few minutes while working the fires. The reason is that the volatile constituents are kept hot and ignited by the fire bed in the back half of the furnace instead of escaping as smoke and vapors. By the time the coal is shoved back it is mostly coke and the vapors are so reduced in volume that they will be burned in the ordinary course of combustion. Between the time of firing and working the fire the door shutters should open so as to supply air for the combustion of the vapors above the fire bed, but they should be closed after the charge is coked to prevent an excess supply of air. Another way of firing is to fire only a little at a time, say two scoops full, and fire oftener. The charge is spread all over the furnace and the door shutters kept a little open all the time so as to make sure that the vapors burn. Another way is to fill up one side of the furnace at a time and open the shutters in the door on the opposite side, if a two-door furnace, or to open them halfway in a one-door furnace. This method is not so economical because some of the vapors in the rear of the furnace will escape without being burned.

The object of cleaning fires is to remove the clinker without removing any more fuel than is necessary. With a poor coal, practically the entire fire is removed, as all the fires in one afternoon must be cleaned together for practical reasons. This is the most trying part of a marine fireman's work and the cause of most of the administrative trouble in firerooms. Criticism should not be made of the character of firemen in general because they are just what conditions have made them. In an oil-burning fireroom, one does not find the character of the fireroom men inferior to any one else aboard the ship, because it is comfortable work; so anything which ameliorates the horrible conditions of the average fireroom raises the character and efficiency of the men aboard. There is no scientific method of cleaning a fire, patience and a good vocabulary being the necessary requirements in separating clinker from the grates. Ash ejectors, hoists, etc., all help, but the best returns are gotten from providing plenty of boilers, so that fair headway can be made when one-quarter or more of the fires are on the floor plates instead of the grates. The greatest help of all is to buy coal that is low in ash. Cleaning fires, then, while no picnic, does not interfere seriously with the schedule. Many a 12-knot steamer of good boiler capacity can pass a 14-knot boat whose boilers are over-

worked on a long run because of the difference in cleaning fires each watch or a difference in coal.

When an ash pan door is one-quarter open it admits the same quantity of air as when it is wide open, and to cut down the supply the door should be open only an inch or one-half inch. Air may be admitted anywhere where there is incandescence and something to burn, but not where things are black hot, no matter whether there is smoke or gas there or not. The proper amount of air admission is ascertained from the appearance of the stack and from the analysis of stack gases. Air should be admitted whenever there is smoke, especially above the grate bars, but the smoke will not burn unless it passes through a zone of incandescence. After the smoke disappears the air may be cut down until a little smoke appears, but some caution must be used, because if the fuel bed be all coked and hot there will be no smoke under any conditions, and a deficiency of air causes the fuel to half burn and give off monoxide, which is half burned gas instead of dioxide, which is wholly burned gas. Both gases are invisible, hence there is no knowledge of the loss, except from a chemical analysis by an apparatus which can be attached to the stack. This apparatus may be in the form of a simple tube, which can be purchased for 75 cents (3/1½), and any engineer can use it; or it may be an automatic recording device making an automatic test every fifteen minutes and recording the results on a dial. In any case the test depends upon the principle that when perfect combustion is taking place from 13 percent to 15 percent of carbon dioxide is formed. If the combustion is imperfect, this percentage is reduced air admitted, the products of combustion show less than in proportion to the imperfection. If there is too much the proper amount of carbon dioxide, but no carbon monoxide. If too little air is used, the products show less than the proper amount of carbon dioxide, but also a proportion of carbon monoxide, or half burned gas. The apparatus, whether of the elaborate or simple type, depends upon the principle that certain chemicals easily obtainable will absorb each of these gases without the others. Many kinds of apparatus are available for the analysis of the products of combustion. None of them costs as much as even a cheap indicator, and far more can be learned from the stack in the way of economy than from indicator cards. The analysis will show just exactly what the furnaces are doing. Analysis may be made also for hydrogen, oxygen, sulphur, moisture and sulphuric acid. Any practical man can make the tests by using the chemicals and following directions, and simple books can be procured which explain the meaning of the analysis.

Excess air causes high stack temperatures, because the excess of air takes heat from the furnace and carries it out the stack instead of giving it up to the boiler. The reason that the heat is not given up to the boiler is that the hot air is lower in temperature than the products would be alone and the heat does not flow into the boiler so fast. The temperature of a stack should be about 600 degrees F. on a good watertube boiler to 1,000 degrees F. on a crowded Scotch boiler. If the temperature in the stack is more than these figures and there is not excess air in the furnaces, either the boiler is being crowded or else it is deficient in heating surface.

There are several means of possible improvement in fireroom conditions, but progress seems to be slow along this particular line of endeavor. It would probably pay some large steamship line to spend some money experimenting with possible devices. Chain grates look promising, if adapted to marine boilers or even if the boiler is adapted to the grate, if necessary; a watertube boiler and chain grate is by no means an unknown combination, and it would elminate the dreadful task and loss of cleaning fires. Down draft Dutch ovens, made after the general design of a gas producer discharging ash from the bottom, have been used on shore with great success and burn soft coals without smoke. Actual gas producers are in operation in Mexico (or were), which feed hot unscrubbed gas to steam boilers.

The use of oil fuel is one of the most rational solutions for conditions in a marine fireroom. Standards of fuel oil are now obtainable all over the world which are as safe as coal, everything considered. It requires less than half of the storage space for the same calorific value and burns with higher efficiency. It dispenses with the bulk of the firemen and their quarters. It is handled, loaded and unloaded without soiling the ship and has numerous lesser advantages. There are many kinds of fuel oil and considerable technique to its use, all of which is discussed at length in easily obtainable books on the subject. The general principles of combustion of oil are the same as already described, and the principles of its use follow in a general way the principles for the combustion of the volatile hydrocarbons in coal.

The next letter will analyze the conversion of heat into pressure by the boiler, and possible economies will be discussed.

E. N. PERCY.

RAILROADS TO RETAIN STEAMSHIP LINES.—The Interstate Commerce Commission has rendered a decision in the applications of the Florida East Coast and the Atlantic Line railroads, under the Panama Canal Act, to continue the operation of the Peninsular & Occidental Steamship Company, whose vessels ply between Tampa, Key West and Miami, Fla., and Havana and Nassau. After the revision of the rates by the railroads, the Commission held that the operation of the steamship company is in the interest of the public, and of advantage to the convenience and commerce of the people.

REINFORCED CONCRETE DOCK AT HOUSTON, TEXAS.—The city of Houston, Texas, has adopted the Cleveland Dock Engineering Company's design for a marginal dock in Buffalo bayou. The dock is to be 777 feet long and about 45 feet wide, consisting essentially of a reinforced concrete beam and girder floor supported out over the water on piles with a buttress wall on the outer margin to retain the fill. It is a freight dock for general purposes and freight can be handled both by crane equipment and by ramps. The dock will cost $298,500 (£61,250), with the addition of about $25,000 (£5,125) for cranes and ramps.

LAKE ERIE ORE DOCK TO BE ENLARGED.—The Pittsburgh & Conneaut Dock Company, a subsidiary of the United States Steel Corporation, will build a new steel and concrete dock equipped with eight ore-handling machines and two 700-foot conveyor bridges at Conneaut, Ohio, on the site of the company's present dock. The new dock will be 2,050 feet long and 1,015 feet wide, with a storage capacity of 8,800,000 tons of ore. Berthing space for four ships at one time will be provided. The construction of the dock will begin about June 1.

LOSS OF LAKE STEAMER S. R. KIRBY.—The first serious disaster of the season on the Great Lakes was the breaking in two and sinking in Lake Superior of the Northwestern Transportation Company's steamer *S. R. Kirby*, with the loss of her crew of twenty men. The vessel was of 2,338 tons and was built in 1890.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, and defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Riveting on Oil Tank Vessels

Q.—I am very much interested in the efficiency of riveted joints, the manner of spacing riveted joints and so on, both in boilers and fuel tanks for sea-going ships. I have noticed that in most oil-burning foreign ships chain riveting seems to be in vogue, while on our own coastwise vessels staggered riveting is the prevailing style. Any information on the above will be gladly received. R. T.

A.—The rules of the principal ship classification societies both here and abroad require the seams and butts of centerline bulkheads, transverse bulkheads, and outside and deck plating in way of oil compartments to be not less than double, chain riveted. Staggered riveting should not be used for shell or oil compartments, and is not so done in new construction. Sometimes a vessel not originally intended to carry oil is modified into an oil carrier or oil burner, and as the riveting which was sufficient for watertightness is insufficient for oiltightness, augmentation of it becomes necessary. It is probable that the instances quoted have some special reason of this sort to account for the riveting being staggered.

Steam Velocities for Short Stroke High Speed Marine Engines

Q.—Would you kindly inform me through the columns of your valuable journal the best steam velocities for short stroke, quick revolution marine engines running at a piston speed of 700 feet per minute to give maximum horsepower? The velocities required are: main steam, high pressure port opening, high pressure port exhaust, intermediate pressure port opening, intermediate pressure port exhaust, low pressure port opening, low pressure port exhaust, exhaust pipe. R. R.

A.—If the engine operates on a boiler pressure of 200 pounds or over the following values are recommended:

Main steam (3 inches to 12 inches diameter), 6,000 to 7,500 feet per minute (velocity increasing with diameter).

High pressure port opening, 6,000 to 6,500 feet per minute (if passages are straightest possible).

High pressure port exhaust, 5,000 to 5,500 feet per minute.

Intermediate pressure port opening, 7,000 feet per minute.

Intermediate pressure port exhaust, 6,000 feet per minute.

Low pressure port opening, 10,000 feet per minute.

Low pressure port exhaust, 7,500 feet per minute.

Exhaust pipe, 6,500 feet per minute.

If the steam pressure is less, you may be forced into using higher values with the attendant greater loss due to wiredrawing. Seaton† suggests these values:

Main steam: 8,100 feet per minute.

Mean of maximum valve openings: High pressure, 7,500 feet per minute; intermediate pressure, 9,000 feet per minute; low pressure, 12,000 feet per minute.

Ports during exhaust: High pressure, 5,800 feet per minute; intermediate pressure, 7,200 feet per minute; low pressure, 8,600 feet per minute.

Exhaust pipe of passage from one cylinder to next: High pressure, 4,500 feet per minute; intermediate pressure, 5,500 feet per minute; low pressure, 7,000 feet per minute.

Ports during exhaust for light high speed engines: High pressure, 5800 feet per minute; intermediate pressure, 8,600 feet per minute; low pressure, 11,500 feet per minute.

Multi-Stage Impulse Turbines

Q.—Is not the De Laval turbine a single wheel turbine with all the expansion taking place in one set of nozzles? We have had a discussion in which I have held the above to be true, and the other side claims to have seen De Laval turbines with several stages each with a set of nozzles giving a pressure drop and with one wheel in each stage. Will you please decide the question for us, and greatly oblige? T. E.

A.—The so-called De Laval type of turbine as originally brought out was a single stage, single wheel turbine with the entire pressure drop taking place in the one set of nozzles. This was necessarily a turbine with extremely high blade velocities, and was usually attached to the machine it was to drive by means of reduction gearing. The patent rights covering the basic characteristics of steam turbines have proven of but doubtful value of recent years, possibly due to the difficulty of convincing a non-technical jury that the technical details discussed are important; at any rate, there has been a gradual tendency of the various turbine manufacturers to depart from the specific type which they first manufactured and to modify its fundamental characteristics to meet the needs of the various units to be driven, and we find the De Laval Company now manufacturing turbines of the "single stage," "multi-stage" and "velocity stage" types, and all, of course, De Laval turbines, though the first-mentioned is the only one that closely follows the original turbine of De Laval. The De Laval "multi-stage" turbine has several stages with a pressure drop to each stage, and the velocity thereby produced abstracted by one wheel, thus simulating the original Rateau type. The "velocity stage" type issued by the De Laval Company has a single pressure stage in the nozzles of which the total expansion of the steam occurs with the kinetic energy of the jets abstracted by passing through two or three sets of moving vanes with stationary vanes between, much as was done in the early Curtis type.

Effect on Steam Consumption of Throttling Dry Steam

Q.—Will you please tell me if, when steam is throttled for the sake of superheating it, there is a gain or loss in the steam consumption? To take a specific case, suppose that steam comes from the boilers practically dry at 260 pounds absolute, and that it is then throttled down to 240 pounds absolute, in which condition it passes directly to the high pressure cylinder. E. B.

A.—Throttling steam the amount you indicate would have but a very slight effect upon the steam consumption of the engine. Theoretically there would be a slight loss, as the thermal efficiency is less in the throttled condition shown by the following computation, but this loss might be counteracted or even more than counteracted by the diminution of the effect of initial condensation, so that the final effect upon steam economy would have to be deter-

* Professor of Marine Engineering, Post Graduate Department, United States Naval Academy, Annapolis, Md.

† Marine Engineering Rules and Tables. Seaton and Rownthwaite.

mined by direct tests. The loss in thermal efficiency is found by computing the efficiency for the ideal or Rankine engine, operating between the pressures given, but with the heat contents at both upper pressures the same which would be the case for a throttling reduction.

In any case, the resultant effect will be very small. Assuming a back pressure of 4 pounds absolute, the efficiency of the Rankine cycle equals

$$\frac{H_1 - H_2}{H_1 - q_2}$$

where H_1 = heat content, initial.
H_2 = heat content, final.
q_2 = heat of liquid at lower pressure (4 pounds absolute).

With dry steam at 260 pounds absolute

H_1 = 1,202 B. T. U.
H_2 = 921 B. T. U.
$H_1 - H_2$ = 281 B. T. U.
q_2 = 121 B. T. U.

$$\text{Efficiency} = \frac{281 \times 100}{1{,}081} = 26$$

With steam throttled from dry at 260 pounds to 240 pounds the heat content H_1 remains the same, and at $P = 240$ and $H_1 = 1{,}202$, the superheat is 4 degrees approximately. H_2 then is for admission expansion 926 B. T. U. and the efficiency is

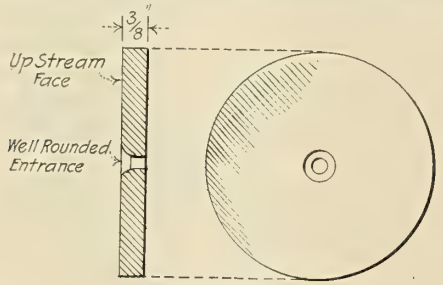
$$\frac{1{,}202 - 926}{1{,}202 - 121} = 25.6 \text{ percent,}$$

which is 0.4 percent less than the first condition.

Steam Consumption of Auxiliaries

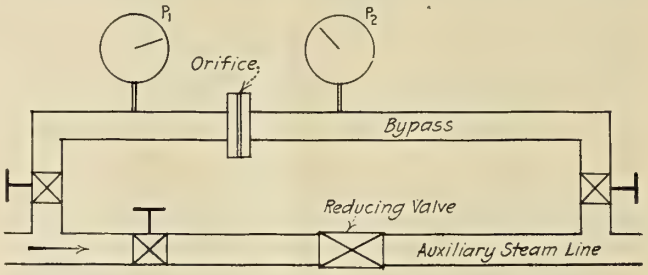
Q.—I have been interested recently in making some economy trials to show the effect of different methods of firing. These have been handicapped by the necessity of running them without interfering with the regular operating schedule of the ship, and, of course, have been made by careful observations of the coal consumption. I have arrived at a place now where it is very desirable that I segregate the coal used for the auxiliaries from that used for all purposes, and I believe the best way of doing this will be to determine the steam consumption total and that for the auxiliaries. The total steam I can get by a meter in the main feed line, but the steam used by the auxiliaries is proving more difficult. Can you suggest a means of obtaining the steam used by the auxiliaries? Have you had experience with any of the steam meters on the market which would warrant an expression of your opinion as to their suitability for this work? Any suggestion you may have will be very welcome to an old subscriber. F. M.

A.—I do not believe that any of the commercial meters for steam will give you as good satisfaction as an ordinary



Sketch of Orifice

curved entrance orifice in quarter or half-inch boiler plate, provided the auxiliaries are operated from a reduced pressure steam line. I have used this aboard ship and in the laboratory, and with a pressure drop such that the ratio $\frac{P_2}{P_1}$ is not greater than 0.85, there should be no difficulty in obtaining an accuracy of at least 2 percent. If there is a reducing valve in the auxiliary steam line, pipe a by-pass of the same size pipe around the reducing valve, and fit this by-pass with a flange connection at the middle of its length. Between these flanges insert the orifice, which can be made of boiler plate with a carefully drilled hole in it. The *upstream* side should be rounded off as in the sketch. Calibrated gages should be tapped into the line just upstream and downstream from the orifice, and readings should be taken at one- or two-minute intervals. The quantity of steam flowing through the orifice will then be given by the following formula, due to Grashof. The area of the hole should be determined by micrometers, and if the fluctuations of pressure are not large the accuracy of the determination will be inside of 2 percent. Below are given a table of the factors to be used in the equation,



Plan of Auxiliary Steam Line with By-pass for Orifice

a plot for the numerical solution of the equation, and sketches of the orifice and the manner of its installation. If the auxiliaries operate on full boiler pressure and the pressure drop is not available it is possible to put the orifice in the exhaust line just before the condenser, and to operate the auxiliaries at an augmented back pressure, but the method is not as satisfactory.

$$w = \frac{a\,P_1^{.97}}{60} \times C$$

w = weight of steam flowing in pounds per second.
a = area of orifice in square inches.
P_1 = initial steam pressure, pounds per square inch absolute.
P_2 = final steam pressure, pounds per square inch absolute.
C = constant from table.

Ratio $\frac{P_2}{P_1}$	Vol. of C.
Less than .58	1.0
.60	1.0
.65	.99
.70	.96
.725	.94
.75	.91
.775	.89
.80	.85
.825	.81
.85	.77
.875	.71

TRAMP STEAMERS OF JAPAN.—According to a consular report from Yokohama, Japan is credited with 272 tramp steamers, displacing more than 1,000 tons each, their combined tonnage amounting to 715,012 tons. Of this number, 112 with a total tonnage of 249,258 are operated by the owners themselves, while 160 with a total tonnage of 465,754 are chartered.

REOPENING OF THE PANAMA CANAL.—After being closed to traffic for seven months the Panama Canal was reopened on April 15, fifteen ships passing through the canal on that date. On April 16 ten vessels and on April 17 eight vessels made the passage, among the latter being the *San Juan*. This was the first Pacific Mail ship to use the Canal. The deepest draft vessels going through the canal during this time was 28.3 feet.

Marine Articles in the Engineering Press

Lighting of Ships—New Vessels—The Screw Propeller —Geared Turbine Machinery—The Cruiser Stern

The Lighting of a Passenger Steamer.—By H. T. Spaulding. This paper introduces the subject by a brief historical sketch of past and present practice in marine lighting. The lighting requirements of a passenger boat are discussed and compared with similar installations ashore. To illustrate how these requirements can be satisfied, the author describes the lighting system designed by him in co-operation with the architects for the steamer *Noronic,* a lake passenger boat, and gives the results of illumination tests in some of the more important portions of the vessel. In conclusion, it is recommended that a departure be made from the ordinary boat lighting systems so current at present, and it is urged that a closer relationship between marine architects and illuminating engineers be established. 8 illustrations. 2,500 words.—*Transactions of the Illuminating Engineering Society,* September.

Passenger and Cargo Steamer Novocastrian.—Built by Messrs. S. P. Austin, Ltd., at the Wear Dock Yard, Sunderland, to the order of the Tyne-Tees Steam Shipping Company, of Newcastle-on-Tyne, for Continental trade. The vessel is 245 feet long overall 34 feet beam and 16 feet 6 inches depth, molded to upper deck, with a gross tonnage of 1,151 and a deadweight carrying capacity of 1,170 tons on a draft of 15 feet 7½ inches. The article describes the structural details, passenger accommodations, life-saving equipment and working arrangements. Propulsion is by a triple expansion engine of 1,500 indicated horsepower, with cylinders 21½, 35 and 59 inches diameter by 39 inches stroke, supplied with steam at a working pressure of 180 pounds per square inch from two Scotch boilers, with a total heating surface of 4,281 square feet. The propelling machinery was supplied by Messrs. Richardsons, Westgarth & Company, Ltd., Sunderland, and the vessel made a speed of 13½ knots on trial; subsequently she was mined and sunk in the North Sea. 6 illustrations. 2,000 words.—*The Shipbuilder,* March.

The Lighting of Ships.—By H. A. Hornor. This paper describes the practical methods of lighting ships in the United States at the present time. The two-wire system of distribution of electricity is generally adopted in merchant vessel practice. The question of insulation and the chemical problems relating to the effect of salt air and salt water upon the materials used in electrical equipment require the greatest care for a practical solution. Generating sets range from one kilowatt, used on small motor boats, to 300 kilowatts, used on battleships. For merchant vessels the prime mover is usually a steam vertical reciprocating engine, chosen on account of its reliability. The steam turbine has been developed as a prime mover, but opinions differ as to their use. Geared turbines have not yet been given a trial in merchant service and the larger units now building for the navy have not yet passed their shop tests. It can be foreseen, however, that probably weight and economy of operation will result from service trials, if the high speed turbine and the reduction gear can withstand the vibration inherent in a ship's structure when under way. The question of searchlights, running lights and night signaling are discussed fully and the current practice in the use of fixtures is outlined. 7 illustrations. 4,300 words.—*Transactions of the Illuminating Engineering Society,* September.

Geared Turbine Propelling Machinery of the S. S. Northumberland.—A series of complete illustrations, showing the geared turbine propelling machinery of one of several vessels fitted by the Wallsend Slipway & Engineering Company, Ltd. The turbine machinery is designed to develop 7,700 shaft horsepower in ordinary service conditions and 9,600 shaft horsepower under trial conditions. The vessel, built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., of Wallsend-on-Tyne for the Federal Steam Navigation Company, is arranged for twin screw propulsion, each line of shafting being driven by a set of Parsons geared turbine machinery consisting of a high and low pressure turbine working in series and coupled to the pinion shafts by flexible couplings, the pinions being seated one on each side of the gear wheel, which in turn is coupled direct to the propeller shaft. The astern-going turbines are incorporated in the exhaust end of the low pressure turbine casings. Steam is supplied under forced draft at a working pressure of 190 pounds per square inch from eight single-ended Scotch boilers, 6 of the boilers being fitted with Schmidt's superheaters, designed to deliver the steam to the turbines at a superheat of 125 degrees Fahrenheit. The article describes briefly the auxiliary machinery in connection with this installation. 10 illustrations. 1,600 words.—*Engineering,* March 17 and 24.

The Screw Propeller.—By Sir Archibald Denny. This paper describes briefly some of the results of model experiments with propellers at the Denny experimental tank. When the Denny experimental tank was opened in 1883 ship models were dealt with first, but shortly afterwards experiments were begun with model screw propellers, both behind models and without models in front of them. Curious differences between real and apparent slip were observed, and an attempt to throw some light on this was made by experiments with a series of screws and a corresponding series of disks and sectors of the same diameters. For the complete disk the resistance increases with increase of revolutions per minute. When the sectors were not revolving the resistances were in proportion to that of the whole disk in proportion to their respective areas. Other factors discussed in this paper included the effect of the following wake and cavitation. As a word of warning, the author expresses the opinion that the ordinary uniformly pitched propeller of the usual shape and section of blade made of suitably pitched diameter and ratio of projected to disk area, cannot generally be improved upon by any unusual design of propeller. The author also emphasizes the fact that the only trial which is really useful for the future study of propellers is the progressive trial with clean bottom surface of ship carried out on a series of runs on a proper measured mile with sufficient depth of water. 3 illustrations. 4,000 words.—*Transactions of the Institute of Marine Engineers,* November.

The Composition of the Exhaust from Liquid Fuel Engines—By Second Lieutenant Robert W. Fenning, R. E. (T.), B. Sc., D. I. C.—This paper describes a method of constructing exhaust gas charts for suitable fuels without the use of an engine and gives the results of numerous experiments consisting of the preparation of mixtures of air and vaporized fuel in known proportions and the explo-

sion of some of the mixtures in a small explosion vessel, the products of which are completely analyzed. The work was undertaken also to increase the evidence as to the composition of exhaust gases, especially with reference to the products of which are completely analyzed. The work ures. Various fuels were employed, the considerations affecting their choice being their volatility, their suitability for motor spirit and their purity. Those selected were hexane and benzone as standard fuels, petrol and commercial benzol as commercial fuels. It was found that with volatile fuels there is but little difference in the composition of the products of combustion resulting from air fuel mixtures in a small explosion vessel or in an engine cylinder in spite of the conditions being so dissimilar. A very small quantity, if any, of unsaturated or saturated hydrocarbons is present in engine exhaust gases. The hydrogen constituent in exhausts from strong mixtures is an important item and increases in value rapidly with increase in mixture strength. The ratio of air to fuel in the original mixtures can be calculated with a considerable degree of accuracy from the composition of the exhaust gases. The reliability of Dr. Watson's method and apparatus for measuring the air and fuel supplied to an engine is once more demonstrated. 9 illustrations. 5 tables. 10,000 words.—*Transactions of the Institution of Mechanical Engineers,* March.

Cruiser Sterns on Merchant Ships.—A consideration of the claims put forward for the adoption of the cruiser type of stern on merchant vessels to reduce the resistance of the hull. It is stated at the outset that the result of the experiments of Froude, corroborated by the subsequent work of Taylor and others, as to the relative effects upon resistance of the shape of the forward and after bodies, has been to lay down the general law that resistance for a given displacement and length of ship depends almost wholly upon three factors: (1) shape of the curve of cross sectional areas; (2) the breadth of the ship, and (3) the fineness of the forward waterline. It is clear that the underwater shape of the section may be varied within wide limits for the whole length of the ship without detrimental effect, but it is also well established that the shape of the forward body is more important in determining the resistance than that of the after body, so that when we apply ourselves to the influence upon resistance of changes of section made wholly in the after body it is not reasonable to suppose that any improvement of a large order is to be looked for. As this is exactly what is claimed in some quarters for the cruiser shape of stern it is evident that the contention does not rest on a very secure foundation. Taylor's experiments with a series of models in which the most radical changes possible were made in the after body sections, showed that the extreme variation possible, without regard to real practical ship-shaped forms, produced changes of resistance of the order of only five percent. It may be estimated, therefore, that such a departure from an ordinary V-shaped design of after body section as is made in passing to the shape used in cruiser stern vessels will not affect resistance more than, say, one-half of 5 percent, at the most, and even this gain is problematical. Incidentally features connected with this form of stern modify somewhat the final judgment of the matter. The cruiser shape of stern allows a wider shape of after waterline and this gives a larger moment of inertia of water plane, and, consequently, a greater metacentric height and greater stability. If the metacentric height of the ordinary shape of ship is already sufficient, advantage may be taken of the increased water plane area to reduce the breadth of the ship, and this is an incidental gain to resistance. Setting one factor against another, it may be assumed that it is not possible to improve the resistance of a ship with a really good ordinary shape of stern more than two or three percent by adopting the cruiser type. 1,100 words.—*The Engineer,* April28.

The Volatile Matter of Coal.—By J. G. O'Neill. The paper explains fully the meaning of the expression "Volatile Matter of Coal," the methods used commercially in the treatment of volatile matter, the constituents into which this treatment divides it and the properties possessed by the products obtained from volatile matter which are of special interest to the navy. By the treatment of coal commercially the volatile matter is divided into four separate products—tar, ammonia liquors, light oils and residual gas. The relative value of volatile matter as regards the calorific value of the coal may be expressed as follows: Fixed carbon or coke, 72.30 percent of total heat. Tar, 5.90 percent of total heat. Light oils, 1.60 percent of total heat. Residual gas, 20.20 percent of total heat. From this it is evident that it is quite important that coal should be so fed to boilers that all of the volatile matter is consumed. 3,500 words.—*Journal of the American Society of Naval Engineers,* February.

The Determination of the Principal Dimensions of Marine Reciprocating Propelling Machinery.—By T. S. Cockrill. A number of rules are given for the use of those engaged on the initial stages of the design of the marine machinery and for estimating. The rules are suitable for all types of vessels, usually fitted with reciprocating engines. As an example, it is assumed that the indicated horsepower and speed of the ship are given, and that it has been decided whether the proposed vessel is to have a single screw or twin screws, but that all other data remain to be fixed. The first step is to decide on the diameter of the propeller. The method is also given for finding the diameter of a wheel for a paddle steamer or stern wheeler. The other data to be obtained are boiler pressure, piston speed, mean effective pressure referred to the low pressure cylinder in multiple expansion engines, cylinder diameters, cooling surface of condensers and heating surface and grate area of boilers. 4 illustrations. 3,000 words.—*The Engineer,* April 14.

Steam Turbine Blade Fastenings.—By James A. Capstaff. In comparing the relative strengths of the turbine blade fastenings made by the Vickers-Ferranti, Brown-Boveri and the Lovekin methods, test pieces of each of these blade fastenings were made up and pulled to destruction. The results of the tests showed the Lovekin blade fastenings to be 61½ percent stronger than the Ferranti method and 56 percent stronger than the Brown-Boveri method. 12 illustrations. 1,000 words.—*Journal of the American Society of Naval Engineers,* February.

A History of Lloyds.—By J. H. Marsden. In outlining the history of Lloyds, the author describes, first, Lloyds of the Royal Exchange, the great center of marine insurance, and then takes up Lloyds Register of Shipping, which is an entirely separate and distinct corporation, working quite independent of the other. Attention is called to the very great changes which have taken place during the past eighty years and which have had to be met by the rules of Lloyds society. In 1834, ten steamers of 500 tons each were built and Great Britain owned only about fifty vessels over 1,000 tons. To-day the tonnage of the Atlantic liner may reach 45,000, and in 1913-14 forty-two vessels ranging from 10,000 to 45,000 tons were classed by Lloyds. 3,000 words.—*The Journal of the American Society of Marine Draftsmen,* April.

Shipbuilding and General Marine News

Contracts for New Ships—Marine Terminal Improvements—Recent Launchings—Improved Appliances—Personal Items

American shipbuilding led the British industry in the first quarter of this year. In the three months ended March 31, 1916, American yards launched 173 merchant vessels of 94,464 gross tons, while British yards, according to Lloyd's returns, launched 69 merchant vessels of 80,561 tons. Merchant ships now building or under contract in American yards are approximating the British output for the future. The total for American yards is 191 vessels of over 1,000 gross tons against 246 in British yards.

Only four merchant vessels were launched in Scottish yards in April, having an aggregate tonnage of 15,171 tons. The Clyde output for the last four months has been only seven merchant vessels with a total tonnage of 24,513.

Steel mills in the United States during the first week in May took orders for 30,000 tons of steel plates, bars and shapes, from shipbuilders of the Atlantic Coast, who have just accepted orders for seven more steamships to be completed during the last half of 1917. The names of the purchasers have not yet been made public, but it is stated that three of the vessels are to be built for Norwegian owners.

Shipbuilding Orders

The Williamette Iron & Steel Works and the North Western Steel Works, Portland, Ore., have received a contract from Hannevig & Johnsen, New York, for the construction of two tramp steamers, each of 8,800 tons deadweight capacity.

M. Mitchell Davis & Son, Solomons, Md., have received an order from the Baltimore & Carolina Steamship Company, Baltimore, Md., to build an oceangoing wooden steamer 200 feet long.

The Sharptown Marine Railway Company, Sharptown, Md., has received a contract from B. B. White, Baltimore, Md., to build a 1,000-ton four-masted schooner.

The Matthew Turner Shipyard, Benecia, Calif., will build three auxiliary lumber schooners 212 feet long for James Robertson.

The Francis Cobb Company, Rockland, Me., has received a contract from Crowell & Thurlow, Boston, Mass., to build a four-masted wooden schooner 200 feet long.

The Maryland Steel Company, Sparrows Point, Md., has received a contract from the Spanish-American Iron Company, Philadelphia, to build a steamship to be used in carrying ore from Cuba.

The Skinner & Eddy Company, Seattle, Wash., has received a contract from the Standard Oil Company, New York, to build two 10,000-ton oil tank steamers.

The W. F. Stone Shipyard, Oakland, Calif., has received a contract from the Hannify Lumber Company, San Francisco, Calif., to build a five-masted lumber schooner to be equipped with two auxiliary engines.

The St. Helens Shipbuilding Company, St. Helens, Ore., has received a contract from the Charles R. McCormick Company, San Francisco, Calif., for the construction of another lumber schooner.

Wilson Brothers, Astoria, Ore., have received a contract from the Charles R. McCormick Company, San Francisco, to build two auxiliary lumber schooners.

Cobb, Butler & Company, Rockland, Me., have a contract from Vane Brothers, Baltimore, Md., to build a four-masted schooner.

E. James Tull, Pocomoke City, Md., has received a contract to build a four-masted wooden schooner for Charles M. Struven & Company, Baltimore, Md.

F. H. Swails, Orange, Tex., will build a five-masted schooner for H. Praggio, Gulfport, Miss.

Shipyard Projects

The Brunswick Marine Construction Company has been incorporated for the purpose of establishing a shipbuilding plant at Brunswick, Ga. The principals in the company are George W. Hinckley, secretary and treasurer of the Apex Equipment Company, New York City; W. U. Taylor, New York City, a lawyer who has long been identified with marine interests; L. J. Nilson, Baltimore, an experienced Swedish shipbuilder, son of a shipbuilder now operating a plant in Sweden; Albert Fendig and C. G. Huggins, of Brunswick. E. L. Huggins, New York City, an experienced naval architect, will assist Mr. Nilson in operating the plant. The company will at first build wooden vessels, but it is the intention ultimately to equip for building steel steamships of all kinds. Operations will start with the construction of four 2,000-ton sailing vessels of the five-mast type, each equipped with engines of 750 horsepower for auxiliary use. These vessels are to be rushed to completion, so as to be put in service while the demand for bottoms is so great and ocean freight rates are so remunerative.

The Scottish-Mexican Oil Company, in co-operation with the Tampico Navigation Company, with which it is closely affiliated has purchased the Marvel Shipyard at Newburgh (N. Y.), where it will construct oil tankers and steel oil barges. Contracts are already in hand for several oil tank steamers of 11,000 tons deadweight capacity each and six 6,000-barrel barges. These vessels are to be built on an actual guarantee of ten percent profit above the cost of construction for the oil tankers and twelve percent for the barges. The new enterprise is known as the Tank Shipbuilding Corporation.

Control of the Tietjen & Lang Dry Dock Company, of Hoboken, N. J., has passed to a syndicate, members of which are believed to be men prominent in the Wall street district. The purchase of the property was made for the account of the syndicate by the banking firm of Bertron & Griscom and Palmer & Co. This successful property, for many years under the presidency of Frederick C. Lang, will be managed by William H. Todd, chairman of the board.

The new shipbuilding plant that is to be established near Portland, Ore., will be known as the Motor Ship Construction Company.

The Rilatt & Barrett Dry Dock Company, of Camden, N. J., has sold out to New York interests. The dock at that plant will be towed to the Philadelphia Ship Repair Company, placed in the drydock to be calked and repaired.

It is stated that plans for the formation of a company to build ten large lumber schooners are under way in Tacoma, Wash. According to report, these will all be four-masted schooners equipped with oil engines.

Captain Alexander McDougall, Duluth, Minn., announces that he is organizing the McDougall & Neath Company, to build a Welland Canal size steamer.

It is announced that work on the new buildings of the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md., will be begun shortly. It is stated that the improvements will cost about $500,000 (£102,500).

The Seaford Marine Railway & Shipbuilding Co., Seaford, Del., has been purchased by A. D. Cummins and others. The new owners are planning to enlarge the shipyard and state that they have already received contracts to build several wooden vessels.

Pendleton Brothers, New York, have purchased the McDonald Shipyard at Mystic, Conn., and will build two four-masted schooners there.

The Pusey & Jones Company, Wilmington, Del., will build a plate and angle shop and will doubtless be in the market for machine tools.

It is stated that work on the construction of the floating drydock of the Galveston Dry Dock Company, Galveston, Tex., will begin in a few weeks. It is planned to build this dock with a lifting capacity of 5,000 tons and later to increase the capacity to 10,000 tons gross. The company plans not only to provide facilities for repairing ships of all sizes, but also to construct a shipyard in which both steel and wooden vessels may be built.

The Valk & Murdoch Company, Charleston, S. C., contemplates building a floating dry dock of about 4,000 tons' capacity and making other extensions and improvements in its shipyards.

Recent Launchings

M. M. Davis & Sons, Solomons, Md., launched on May 4 the Coast Guard cutter *Tioga,* a vessel 80 feet long, intended for the customs service in the Baltimore district.

The Standard Oil tanker *Acme,* which is 450 feet long by 56 feet beam by 32 feet depth, with a capacity of 80,000 barrels of oil, was launched at the Union Iron Works, San Francisco, Cal., on April 29.

The Munson liner *Munalbro* was launched by the Maryland Steel Company, Sparrows Point, Md., on May 6.

The tank steamer *Standard Arrow,* which is 468 feet long and has a capacity of 4,000,000 gallons, was launched by the New York Shipbuilding Company, Camden, N. J., on May 15. The vessel is building for the Standard Transportation Company.

The first of a fleet of six steel auxiliary schooners, designed by Cox & Stevens, naval architects, New York, for the Standard Oil Company, of New Jersey, was launched by the Toledo Shipbuilding Company, Toledo, on April 20. The vessel, which was christened *Starlight,* is of Welland Canal size, 261 feet long by 46 feet 6 inches beam by 23 feet 6 inches depth of hold. The vessel is rigged as a four-masted schooner and will carry as auxiliary power a 400 horsepower Bolimders heavy oil engine. This fleet of vessels will be used by the Standard Oil Company in the package freight trade on the Atlantic coast.

The turbine-driven steam yacht *Winchester,* designed by Cox & Stevens, naval architects, New York, for Mr. P. W. Rouss, of the New York Yacht Club, was launched at the Bath Iron Works, Bath, Me., on April 29. The builders' trials were held over the Government course at Rockland, Me., on May 15, where the vessel developed a speed of 31.6 knots, which is 1.6 knots above the contract speed. The yacht is 225 feet long by 21 feet beam, propelled by a twin screw arrangement of Parsons turbines, designed to deliver 7,500 shaft horsepower. Steam is supplied by two Normand oilfired watertube boilers.

The S. S. *Sucrosa,* under construction at the yards of the Fore River Shipbuilding Corporation, Quincy, Mass., for the Cuba Distilling Company, New York, was launched on May 6. The *Sucrosa* is a two-deck vessel with poop, bridge and forecastle. She is 389 feet long, 54 feet 6 inches beam and 32 feet 6 inches depth to upper deck. On a mean draft of 25 feet she will carry about 1,500,000 gallons of molasses. Propulsion is by a vertical triple expansion engine with cylinders 25, 41 and 68 inches diameter by 48 inches stroke, supplied with steam at a pressure of 190 pounds per square inch from three single-ended Scotch boilers having a total heating surface of 7,407 square feet.

Annual Convention of the American Society of Marine Draftsmen

Delegates from the various branches of the American Society of Marine Draftsmen assembled at the rooms of the Newport News Branch, in Newport News, Va., on Friday morning, April 21, and were welcomed by Honorable B. B. Semmes, mayor of Newport News; Mr. John I. Viney, president of the Newport News Chamber of Commerce, and Colonel W. S. Copeland, editor of the Newport News "Times-Herald."

Following the addresses of welcome Mr. J. E. Schmeltzer, national president of the society, was called to the chair and the business session was opened. The following delegates were present:

Branch No. 1, Delaware River, W. A. Roes and W. A. Leavitt, Jr.

Branch No. 2, Norfolk, J. B. Sadler and A. W. Chase.

Branch No. 3, Boston, C. S. Adams.

Branch No. 4, Quincy, J. O. McDonald.

Branch No. 5, Washington Navy Yard, G. W. Nusbaum and W. E. Rose.

Branch No. 6, Newport News, A. H. Haag, J. A. Kelly, S. C. Jenkins and I. H. Osborne.

Branch No. 7, Portsmouth, A. H. Frost.

Branch No. 8, Connecticut, A. C. West.

Branch No. 9, New York, P. I. Hichborn, W. H. Carter and T. S. Welch.

Branch No. 10, District of Columbia, W. S. Buckley and W. B. Newton.

Branch No. 11, Mare Island, proxy, R. M. Wagstaff, Norfolk.

Branch No. 12, Bath, R. C. Cowles.

Branch No. 13, Bridgeport, R. F. Hill.

Branch No. 14, Puget Sound, not represented.

Branch No. 15, Fore River, Government, proxy, C. S. Adams, Boston.

Branch No. 16, Charleston, S. C., not represented.

Branch No. 17, Baltimore, not represented.

After various amendments to the constitution and by-laws were proposed, the annual reports of the officers and executive committee were read and accepted. Reports were also read from the Economics, Publication, Emblem and Supplies Committees and from each of the branch societies.

At the end of the morning session, New London, Conn., was selected as the meeting place for the next annual convention.

At the Friday afternoon session the following officers were elected for the ensuing year:

President, G. W. Nusbaum, Washington Navy Yard Branch.

Vice-President, Alfred H. Haag, Newport News Branch.

Secretary, B. G. Barnes, Quincy, Mass., Branch.

Treasurer, P. K. Thurston, District of Columbia Branch.

Member of Executive Committee, H. A. Hunt, Bridgeport, Conn., Branch.

Following the election of officers action was taken on the proposed amendments to the constitution.

During the Saturday morning session charters of the Bridgeport, Puget Sound, Fore River Government, Charleston, S. C., and Baltimore Branches were ratified.

Mr. Luther D. Lovekin, chief engineer of the New York Shipbuilding Company, Camden, N. J., was elected an honorary member of the Society.

The unsatisfactory conditions in the drafting department of the New York Navy Yard led to the adoption of a resolution requesting Congressional investigation of conditions at the yard. It was also voted that the society be authorized to take up through the economics committee the question of increased pay for draftsmen in private concerns commensurate with the general improvement in economic conditions throughout the country.

At the Saturday afternoon session a resolution was passed heartily indorsing President Wilson's preparedness plan.

On Friday night the visiting delegates and members of the Newport News Branch were the guests of the Norfolk Branch at a smoker given in the Norfolk Chamber of Commerce Club. The party was brought to Norfolk on the S. S. *Virginia,* accompanied by the shipyard band, and after making a short parade through the streets of Norfolk and attending the theater and smoker, the party returned to Newport News on the steamer.

On Saturday night the annual dinner was held at the Warwick Hotel, Newport News. Mr. Saunders Van Aucken acted as toastmaster and the principal address was made by Mr. Alvah H. Martin, of Norfolk, Va., a member of the National Republican Committee. Other speakers included Mr. H. F. Gateley, Admiral F. M. Boggs, J. E. Schmeltzer, retiring president; G. W. Nusbaum, president-elect; A. H. Haag, vice-president; John I. Viney, president of the Chamber of Commerce; R. P. Adams, chief draftsman, Norfolk Navy Yard, and W. S. Copeland, editor of the *Times-Herald.*

Marine Terminal Improvements

The Public Service Commission, New York, has approved plans submitted by the New York Dock Company for the construction of large piers at the foot of Joralemon and Montague streets, Brooklyn, N. Y.

The legislature of Tennessee has been asked to authorize the City of Nashville to issue $250,000 (£61,250) in bonds for wharf terminals and connections on the Cumberland River.

The Attorney-General of Texas has approved a bond issue of $1,000,000 (£205,000) by the City of Houston for wharves and harbor improvements.

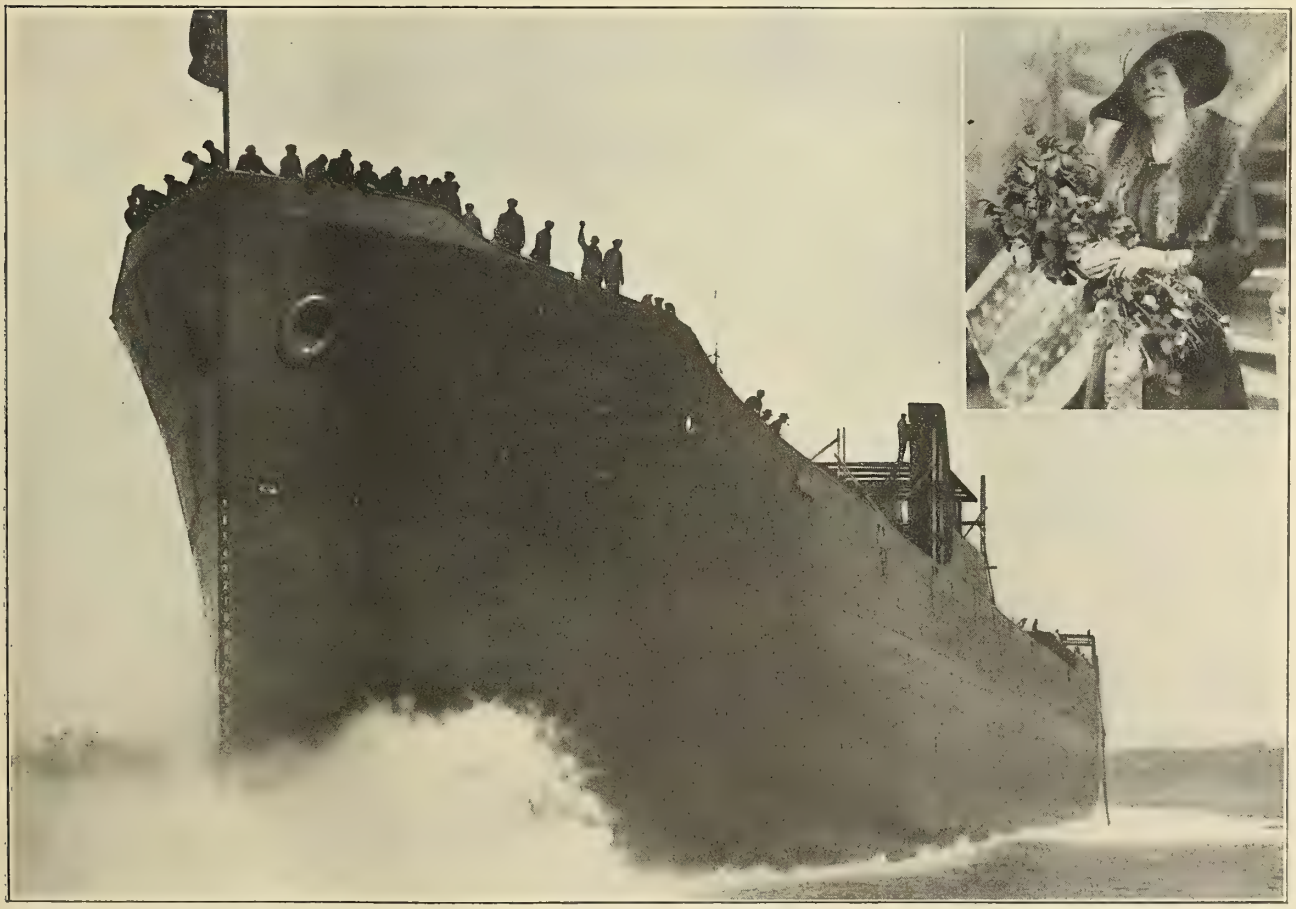
The North Vancouver Lumber Company, North Vancouver, B. C., has applied for permission to build a wharf at the foot of St. George's avenue, North Vancouver.

The City of New Haven, Conn., is planning a bond issue for the extension of the New Haven Public Wharf.

The City of Selma, Ala., will build a wharf of stone and concrete construction.

The New England Steamship Company, Boston, Mass., is planning to build a new wharf at Providence, R. I.

It is reported that five large municipal piers will soon be built along the water front in Philadelphia.



Launch of the Molasses Steamer *Sucrosa* at the Fore River Yard on May 6. Insert Shows the Vessel's Sponsor, Miss Dorothy E. Brady.

ENGINEERING SPECIALTIES

Coston Davit Turning Gear

One of the earlier disadvantages of worm and screw gearing for manipulating boat davits on board ship was that when exposed to the weather in the winter time ice and snow and other foreign matter would freeze and clog the gears. The Coston Signal Company, New York, has solved this difficulty, it is claimed, in a most satisfactory manner by fitting a housing around the gearing, impinging upon a collar cut in the main hub and allowing the housing to turn freely when the gear is working. This housing completely encloses the gearing, but allows it to be freely lubricated. It also serves the purpose of taking

Coston Gear for Turning Round Bar Davits

the thrust of the high-grade steel holding shaft which passes through the flexible eye of a standard secured to the ship's deck. The holding shaft thus prevents the housing turning when the davits and gear are working. The driving shaft connecting the powerful gearing is therefore free to work the quadruple gears in the housing and so swing the davits and boat.

Another difficulty which the Coston gear has solved is the method of allowing the gear to work freely, irrespective of the spring or bending of the davits. This is accomplished by a flexible elongated eye on the standard through which the thrust or holding shaft is placed. This eye allows the shaft to move at any angle which the davits may take. In case of an accident or the like, the gear can be readily detached. All that is required to be done is to remove the vertical pin which passes through the eye into the deck standard, and the davits are free to turn irrespective of the gearing. This is a factor of great advantage, as the gears or davits can be readily cast adrift should it be necessary to do so. Furthermore, the gearing can be uncoupled in another way if desired by the removal of a set screw which would allow the thrust shaft to be removed quickly and so release the gear.

The quadruple gears of the Coston device are so arranged that one man at each davit can readily turn in or outboard the largest lifeboat, even though the ship is listed. The gears are all cut of high-grade steel; in fact, the best thought and skill in design and workmanship have been put into this mechanism, making it efficient in every respect. The gear is comparatively light in weight and the cost of its installation on board ship is nominal. No alterations have to be made to ship's decks and no rearrangement of boats and davits is necessary.

The gear has been approved by engineers, classification societies and the United States Steamboat Inspection Service, and is being installed on a large number of ocean and coastwise vessels, including the American liners *St. Paul, St. Louis, Philadelphia* and *New York,* the Panama Pacific liners *Kroonland* and *Finland,* several of the American-Hawaiian Steamship Company's vessels, the *Crofton Hall* of the Isthmian Steamship Company, the *Ioannina* of the Greek Line, and the *Manuel Calvo* of the Spanish Line.

I. O. C. Bipolar Oxygen and Hydrogen Generator

The demand for oxygen and hydrogen for various industrial uses has grown very rapidly in the last five years. Certain lines of manufacture have been built up based on the oxygen process of welding, such as welded tanks, steel barrels, automobile parts, tubes, etc., while for repairing broken machinery, for reclaiming castings, for metal cutting of every nature, oxygen and hydrogen or oxygen and acetylene are used in steel mills, railroad shops, foundries and down to the smallest machine shop. Hydrogen likewise is in active demand; it is used more and more for cutting purposes and for light welding. This rapid development in the uses of two gases was facilitated by the introduction into this country of oxygen and hydrogen generating apparatus several years ago. Large users of one or both of these gases were thus enabled to obtain their supply direct from their own generating plant at

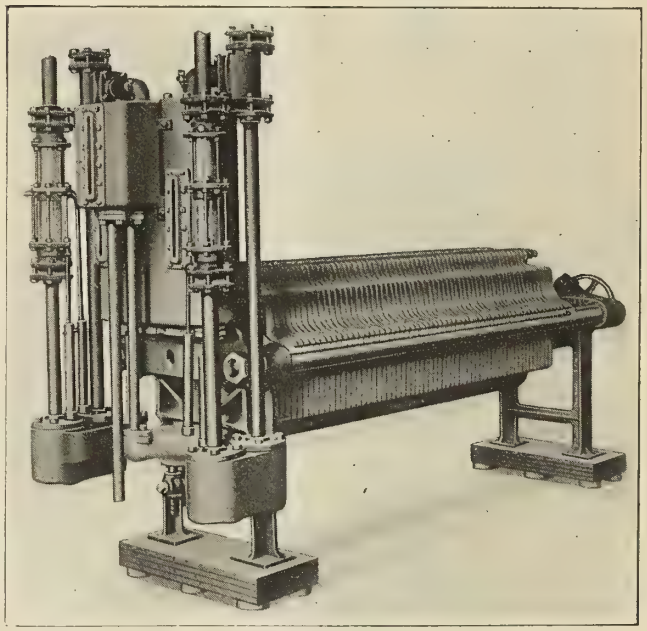


Fig. 1.—I. O. C. Bipolar Oxygen and Hydrogen Generator

low cost, in a manner suitable to their individual requirements.

In the field of oxygen and hydrogen generating equipment the International Oxygen Company, of New York, from the beginning set a standard for high-grade apparatus of workmanlike design and security of operation. The type of machine manufactured by this company known as the I. O. C. unit type is recognized as a most

efficient and high-class apparatus and is in successful operation in numerous plants throughout the country. To-day the International Oxygen Company is bringing out a new style of oxygen and hydrogen generator under the name of the I. O. C. bipolar generator. This type of

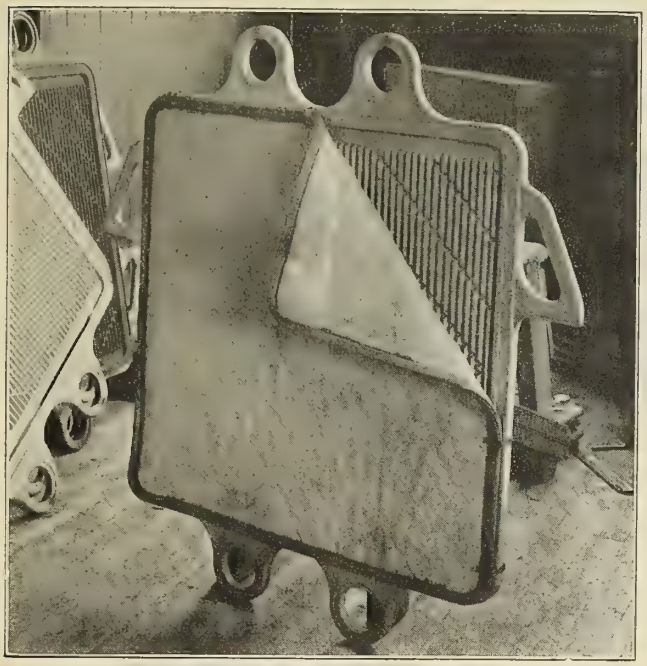


Fig. 2.—Electrode and Diaphragm

generator resembles outwardly a filter press such as used in many chemical industries. Moritz, of Wasquehal, France, patented this type of apparatus in the United States and elsewhere, and I. H. Levin, of the International

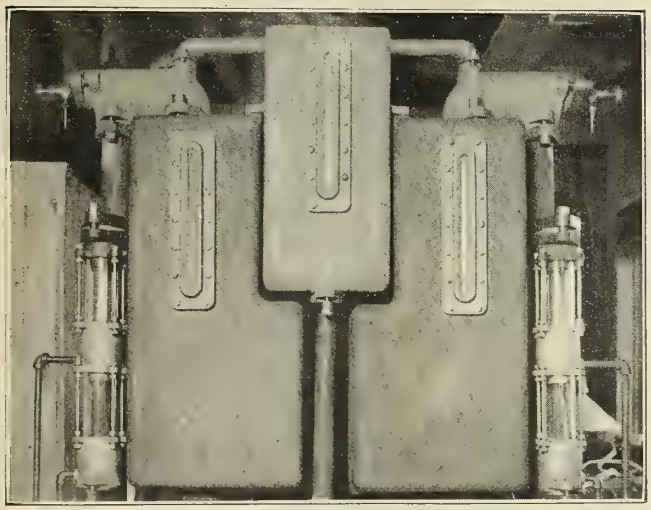


Fig. 3.—Water Tank and Gas Domes

Oxygen Company, who studied under Moritz and Flamand, perfected this machine.

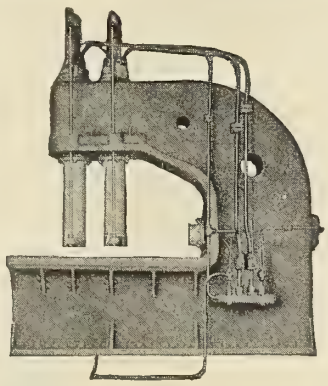
Briefly described, the I. O. C. bipolar generator consists of a series of metallic plates (electrodes) clamped up together in a heavy frame, electrically insulated from one another, and separated by diaphragms of porous fabric. Each pair of these electrodes forms a closed cell divided by the diaphragm. These cells are filled with the electrolyte (caustic potash or soda), which acts as a conductor. An electric current admitted at one end plate passes on through the plates and the solution to the other end plate. In its passage it decomposes the water in the solution into the two gases—oxygen and hydrogen—which are released on opposite sides of each plate and emerge upward into the gas off-takes. The mingling of the oxygen and hydrogen in each cell or compartment is prevented by the diaphragm, which, while permitting the passage of the fluid, resists the passage of the gases, according to a well-known physical law. As the gases are released and withdrawn the solution is automatically replenished from a supply tank. The operation is continuous so long as current and electrolyte are supplied.

The electrodes are of a special patented design, the anode side being heavily nickeled, while the cathode side is of commercially pure iron. The two gas off-takes discharge into two independent gas domes, the gas emerging below the fluid surface through an inverted "U." The pressure on both gases, clear back to the individual cells, is the same—being that determined by the hydrostatic head in the domes through the two independent risers from the water-feed manifold. This balanced pressure in both gas off-takes forbids any mixture of the gases and contributes to the balancing of pressures on the diaphragms. Both gas and water pressures are predetermined and constant.

The gases, escaping from the gas off-takes, rise through the fluid in the gas domes and pass out through discharge pipes at the top of the domes—thence downward to purgers in either side. The function of these purgers is threefold: first, to catch any entrained fluid in the gas; second, to cool the gas; third, to act as a water-check valve protecting the pressure system of the generator from any undue pressure of the gas-holders.

Southwark Standard 200-Ton Sectional Flanging Press

The Southwark standard 200-ton sectional flanging press, illustrated, which is used in boiler shops for flanging boiler heads and for other miscellaneous work, has two vertical rams of 100 tons capacity, one horizontal ram and one supplementary ram. The housing is cast of open



Southwark Flanging Press

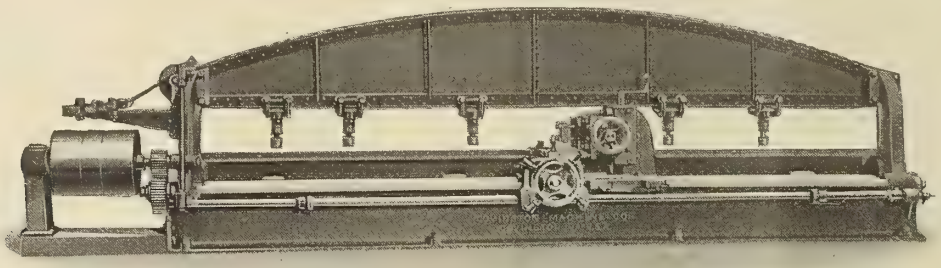
hearth steel and all of the cylinders are open hearth steel castings inserted in the housing.

The operation of the machine is accomplished by using the outer vertical ram for clamping; the inner vertical ram for flanging and the horizontal ram for squaring up the flange, or for holding the backing-up bracket, while the inner vertical ram is doing the flanging work. There is also a lower ram located between the two vertical rams, which is used for clamping and stripping.

This machine is manufactured by the Southwark Foundry and Machine Company, Philadelphia.

Covington Plate Planer

A tool of special interest to shipbuilders is the plate planer shown in the illustration, which is manufacured by the Covington Machine Company, Covington, Va. The plate planer illustrated is of small capacity with hand-operated jacks for holding the plate. Air jacks may be substituted for the screw jacks on larger machines. The planer is equipped with two tools, one for cutting in the right-hand direction or motion of the carriage and the other for cutting in the left-hand direction. In other words, it cuts going and coming, and there is consequently no loss of time. Two cuts are usually all that are necessary to straighten the edge of a plate and this may be cut square or at a bevel.



Covington Plate Planer

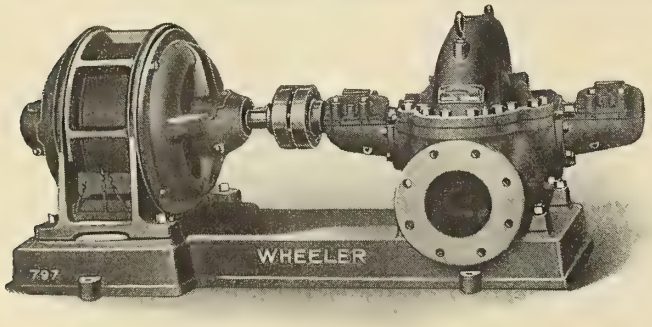
The planer bed is made of semi-steel of box construction designed for rigidity. The housings are also of semi-steel of box construction. The girder which is attached to the housing is a steel plate girder in all cases. The machines are supplied for both belt and motor drive and are designed to cut at the rate of 20 feet per minute.

Wheeler Centrifugal Pumps

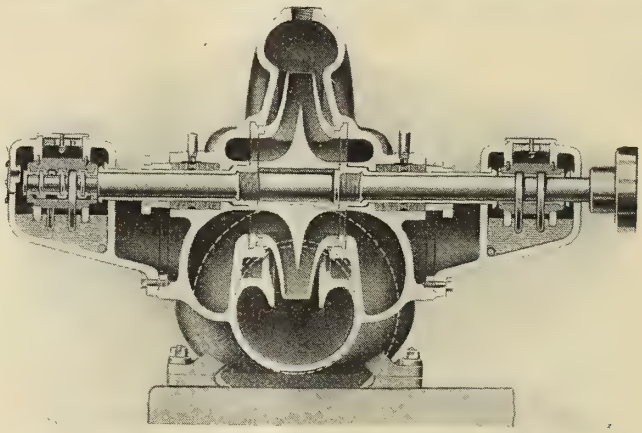
The Wheeler Condenser & Engineering Company of Carteret, N. J., is now building a line of horizontal and vertical shaft centrifugal pumps for general services as well as for condenser work. This company has been building centrifugal pumps for over twenty years, most of them being used, however, in connection with condensers. The new line of pumps is suited for all services.

A small motor-driven unit for tank or stand pipe operation is shown in Fig. 1. Referring to Fig. 2, it will be seen that this pump conforms to the most recent advances in centrifugal pump construction, having a two-part divided casing, with the suction and discharge nozzles in the lower half. The impeller is of closed double suction type, protected by labyrinth wearing rings. The shaft is protected from the water by bronze sleeves, which screw onto the shaft and extend clear through into the bearing bracket boxes. Bearings are of the ring-oiled type, and in the outboard bracket there is located a ring-oiled thrust bearing, which is a refinement not usually found in double-suction single-stage pumps. A feature of these pumps is the large size of the bearing brackets and the fact that they are bolted to the pump casing instead of being cast integral with them.

In manufacturing, particular attention is given to the casting of impellers, since the work of the designer in selecting the correct impeller dimensions may be entirely defeated by crude or careless shop work. The impellers are cast in dry sand or skin dry molds, and the cores are made from a core "sand" which is in reality a fine powder, which, when properly mixed and weathered and baked into a core, gives a surface to which the metal adheres perfectly. The result is that the finished impeller is a perfect casting, true to pattern.



Typical Small Motor-Driven Pump for Tank or Stand Pipe Service. Capacity 1,000 Gallons per Minute



Sectional View of Wheeler Centrifugal Pump, Showing Water Passages in Casing and Impeller, Also Shaft Protecting Sleeves

Japanese Line Buys Former Pacific Mail Steamers.—An example of the enormous enhancement in the value of steamships since the war brought about an unprecedented demand for vessels, was furnished recently in the announcement that the International Mercantile Marine Company had sold two of the steamships purchased by it last fall from the Pacific Mail Steamship Company. In that deal, five liners—the *Korea*, the *Siberia*, the *China*, the *Manchuria* and the *Mongolia*—were bought for $5,250,000 (£1,075,000). The *Korea* and the *Siberia* have now been sold to the Toyo Kisen Kaisha for $4,000,000 (£820,000). These vessels were acquired by the International Mercantile Marine Company from the Pacific Mail Steamship Company for the sum of $2,000,000 (£410,000).

PERSONAL

Henry J. Romely, formerly navy inspector of the Lake Torpedo Boat Company, Bridgeport, Conn., has been appointed assistant marine superintendent of that company.

Holden A. Evans, vice-president and general manager of the Baltimore Shipbuilding & Dry Docks Company, Baltimore, Md., has been made president of the company.

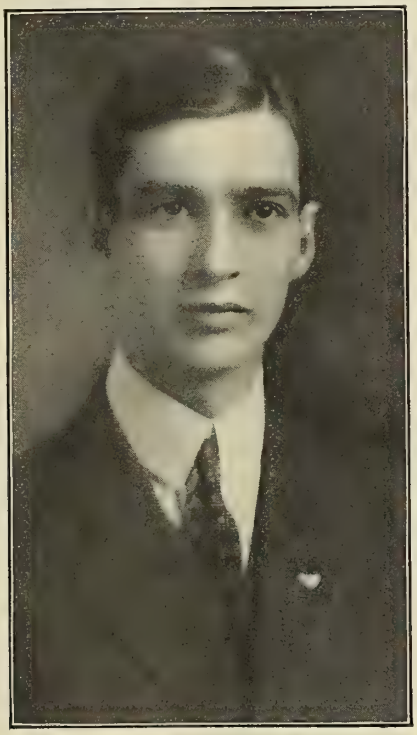
G. H. Barber, formerly chief draftsman of the Scientific Department, Hull Division, New York Navy Yard, has been appointed assistant engineer of the Interocean Submarine Engineering Company, Inc., New York.

James H. Mancor, Lloyd's principal surveyor for the United States and Canada, retired from active service on May 1. Mr. Mancor came to the United States in 1894 and was the first exclusive engineer surveyor sent by Lloyds to America. In 1905 he was appointed principal surveyor for the United States, and in 1910 his jurisdiction was extended to include Canada. Mr. Mancor is now attached to the staff of the British Consul General in New York.

James French, formerly principal surveyor of Lloyd's Register of Shipping at Glasgow, has been appointed chief surveyor for the United States and Canada, succeeding Mr. James H. Mancor, whose retirement is noted above. The vacancy at Glasgow has been filled by the appointment of James Montgomerie, formerly assistant to the chief ship surveyor at London.

OBITUARY

James C. Eckliff, vice-president of the Eckliff Automatic Boiler Circulator Company, and inventor of the boiler circulator which this company manufactures, died of typhoid fever at his home in Detroit on May 9, aged 29 years.



James C. Eckliff

Mr. Eckliff was born in Detroit on June 27, 1887, and was educated in the Detroit schools. For several years he was in the steel business, representing the Vulcan Crucible Steel Company. In 1911 the Eckliff Automatic Boiler Circulator Company was organized for the purpose of manufacturing the automatic boiler circulator and the success of this company has been attributed largely to Mr. Eckliff's efforts. The news of Mr. Eckliff's death came as a shock to his many friends, as he had been at the company's office every day up to May 5, when it was believed he was suffering from a bad cold, which eventually proved to be typhoid fever.

Albert M. Winge, member of the firm of King & Winge and one of the leading men in the development of Seattle, Wash., as a shipbuilding center, died in Seattle on April 22, aged forty-eight years.

Dan H. McInnis, chief engineer; Thomas C. Salter, first assistant; William J. Holland, second assistant, and Fred Havard, third assistant engineer of the S. S. *Roanoke,* owned and operated by C. P. Doe Company, San Francisco, Cal., which foundered off the coast of California on May 9, are reported missing, and it is presumed that they were all lost with the ship. Mr. Holland had just relieved his brother-in-law, Douglas Mitchell, former second assistant engineer of the vessel, for this one voyage while Mr. Mitchell was taking a vacation.

John Edson Sweet, founder and past president of the American Society of Mechanical Engineers, died suddenly at Syracuse, N. Y., on May 8, aged eighty-four. Throughout his life Professor Sweet held a foremost place in the mechanical engineering field. For a number of years he was a professor at Cornell University and since 1880 he has been president and general manager of the Straight Line Engine Company, Syracuse. In 1914 he was the recipient of the John Fritz medal, and during the same year he received from the Syracuse University the degree of Doctor of Engineering.

Danish Ships of 1776 Pressed Into Service.—A remarkable example of the extraordinary straits to which shipping has been reduced for want of vessels is told in a dispatch to the "Ekstrabladet" from Svendborg, Denmark. Anything that can be floated is being pressed into service. Two sailing sessels, the *Marie of Troense,* built in 1776, and the *Tvende Brodre,* built in 1786, have been rigged up and sent out to enter the competition for the enormous freight rates which are now being offered everywhere.

British Columbia to Aid Shipbuilders.—Provision for aid to the aggregate amount of $2,000,000 (£410,000) to the shipping and shipbuilding industry of the province is contained in a bill which Premier Bowser has introduced in the British Columbia Legislature. According to the *Iron Age* the bill proposes the creation of a commission which will have control of the administration of the act. Loans will be made to the amount of 55 percent of the value of the ships built under the supervision of the commission. These loans will be paid to the owner of each ship up to the number of not more than twenty ships, constructed after the coming into effect of the act, in ten annual instalments, each instalment being computed as to bring the net earnings of the ship up to 15 percent of the actual cost. The subsidy paid in any one year shall not amount to more than $5 (1/0/10) per ton deadweight capacity, the first annual payment to be made in the first year after peace is declared and thereafter annually.

It is stipulated that this subsidy shall be paid only as long as the ship remains in continuous British Columbia service; that is, carries cargoes from British Columbia and brings return cargoes to the province. Provision is also made for aid to shipbuilding plants to the extent that the commission, subject to the approval of the Lieutenant-Governor-in-Council, may advance in securities to the amount of 55 percent of the actual cost of such plant, as certified by the commission, and after the commission has assured itself that the company can furnish ample security to protect the government.

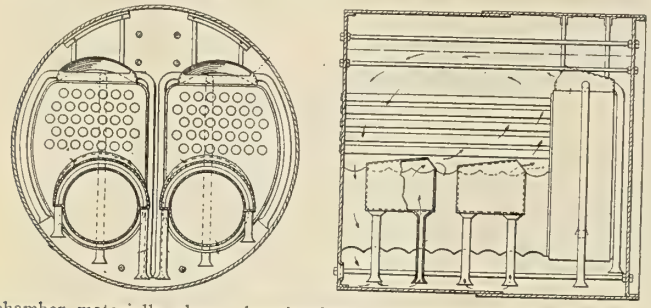
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents, compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,168,881. CIRCULATOR. F. WALTER GUIBERT, OF DETROIT, MICH.

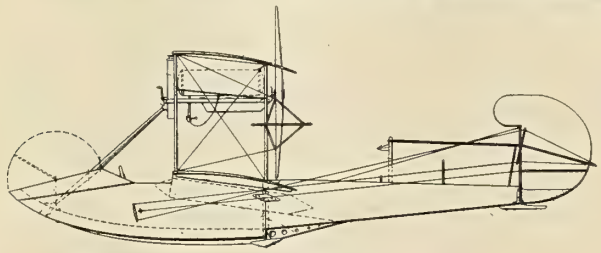
Claim 1.—In combination with a boiler provided with a furnace chamber and a combustion chamber, a circulator system comprising one or more circulators adapted to rest on the furnace and arranged to discharge in one way alone, and a circulator located on the combustion



chamber materially above the circulator or circulators on the furnace and arranged to discharge in directly opposite direction to the direction of discharge of the circulator or circulators upon the furnace. Two claims.

1,170,965. HYDRO-AEROPLANE. GLENN H. CURTISS, OF HAMMONDSPORT, N. Y., ASSIGNOR TO THE CURTISS MOTOR COMPANY, OF HAMMONDSPORT, N. Y., A CORPORATION OF NEW YORK.

Claim 1.—A hydro-aeroplane comprising a boat structure having a horizontally disposed, broad, upwardly inclined landing prow, an aerial supporting surface arranged transversely of said boat structure near the prow thereof, a base adapted to support a body of relatively large mass



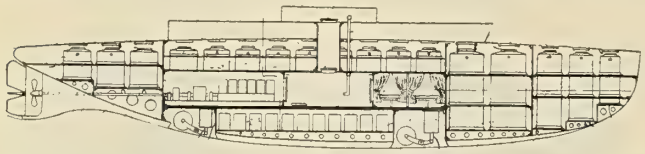
in elevated position above the body of said boat structure and in the rear of the prow thereof, a brace inter-connecting directly the front end of said base and the said prow of the boat structure, and a cockpit provided with a seat for an operator located in said boat structure below said brace. Twenty-two claims.

1,166,331. METHOD AND APPARATUS FOR SAFEGUARDING NAVIGATION. ALBERT G. DAVIS, OF SCHENECTADY, N. Y., ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

Claim 1.—The method of safeguarding navigation which consists in producing at a common point a direct indication of the difference in temperature of two different points in air or water about a ship, said two different points being so related with respect to the ship that a change in the normal difference in temperature of the air or water at these points is indicative of the presence of ice near the ship. Ten claims.

1,169,970. SUBMARINE BOAT. SIMON LAKE, OF MILFORD, CONN.

Claim 1.—A cargo-carrying submarine or submersible boat, comprising an outer hull and an inner hull, cargo-carrying tanks arranged in the



spaces formed by said outer and inner hulls, the spaces formed by said inner and outer hulls around said cargo-carrying tanks providing water-ballast compartments. Eight claims.

1,162,223. SUBMERGED EXHAUST AND BILGE-WATER-REMOVING DEVICE FOR MOTOR BOATS. GEORGE M. CRAM, OF PORTLAND, MAINE.

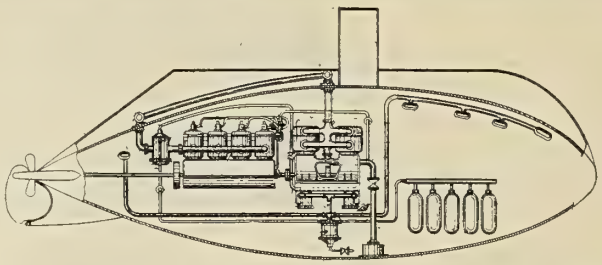
Claim 1.—In combination a boat, a casing secured to the bottom of said boat, said casing embodying in its construction a passage extending longitudinally of said boat, said passage having an outlet chamber and an inlet chamber, said inlet chamber having an inlet orifice directed toward the bow of said boat and a discharge orifice substantially smaller in diameter than said inlet orifice and communicating with said outlet chamber, said outlet chamber having a suction passage connected therewith in close proximity to said discharge orifice and constituting an exhaust passage, said outlet chamber having a second suction passage adjacent to said discharge orifice, said second passage constituting a bilge water outlet, and a valve arranged in said second passage adapted to be operated to permit or prevent the passage of fluid through said second passage. Three claims.

1,163,606. GYROSCOPICALLY CONTROLLED TORPEDO. HAROLD W. SHONNARD, OF NEW YORK, N. Y., ASSIGNOR TO CRUCIBLE STEEL COMPANY OF AMERICA, OF PITTSBURG, PA., A CORPORATION OF NEW JERSEY.

Claim 1.—In an automobile torpedo, the combination with steering mechanism, of an electric motor gyroscope for controlling such mechanism, and a single movable member for locking the gyroscope and for making and breaking an electric circuit therethrough. Thirteen claims.

1,172,992. SUBMARINE. ALLEN HOAR, OF LONG BEACH, CAL., ASSIGNOR TO ABNER R. NEFF, OF LOS ANGELES, CAL.

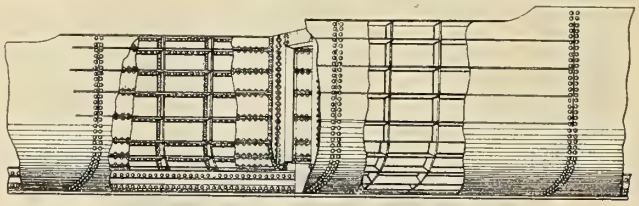
Claim 1.—In a submarine, in combination, a hull having an engine compartment, a combustion power plant in said compartment, means for



discharging overboard the products of combustion, air storage means, and means driven through the energy of the compressed air in said air storage means for operating said discharge means. Eleven claims.

1,173,432. BOAT. HENRY W. JACOBS, OF TOPEKA, KAN.

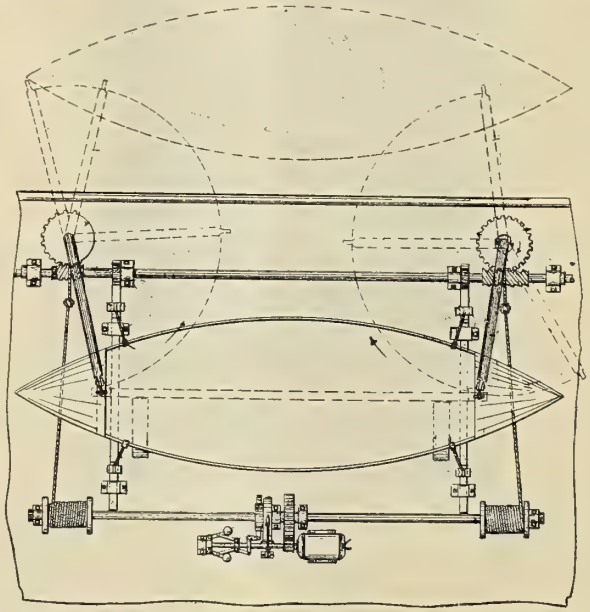
Claim 1.—A boat provided with an inner and an outer wall composed of sheet metal flanged sections, the flanges of adjacent sections being secured together with intervening stay-sheet members whereby longitudinally disposed ribs are provided and the walls maintained in proper



spaced relation to each other, some of the intervening stay-sheet members along the bottom of the boat being of greater width so as to extend to the outside of the outer wall, and flanged sections secured together and extending transversely of the boat so as to provide bulkheads. Three claims.

1,173,821. SHIP'S DAVIT. WILLIAM LUEDER, OF SAN FRANCISCO, CAL.

Claim 1.—A life boat handling apparatus comprising the combination with a support for the boat, of lashing lines and chocks for the boat, a



pair of ship's davits to which supporting cables from each end of the boat extend, a shaft extending to both of the davits, a slidable worm and a fixed worm on said shaft, a gear on each davit in mesh with said worms whereby the davits may be turned outboard, a pair of slides for holding the lashings and chocks, and a pair of pinions on the shaft for moving said bars to release the lashings and chocks. Two claims.